May, 1934

Railway Engineering Maintenance

Rail Joints

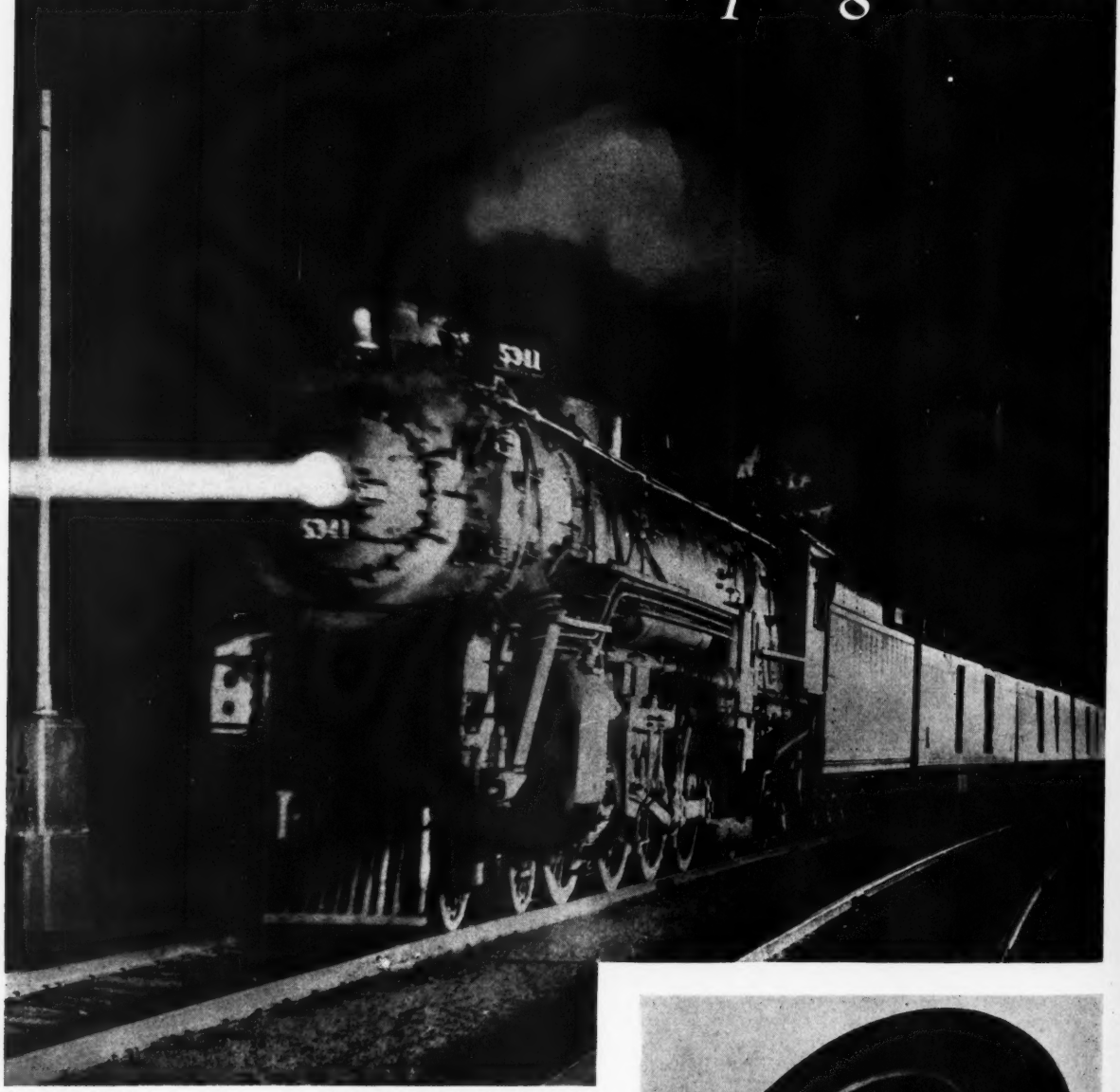
HEADFREE, BALANCED *and*
CONTROLLED BEARING TYPES



THE RAIL JOINT COMPANY

BROADWAY NEW YORK, N. Y.

Reliance HY-CROME *Spring Washers*



THE MISSOURIAN ONE OF AMERICA'S FAMOUS TRAINS

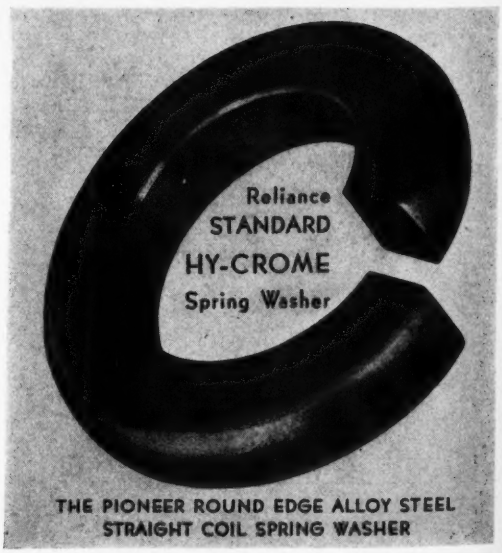
ORIGINALLY known as the Government Fast Mail, the *Missourian* of the Missouri Pacific Lines operating between St. Louis and Kansas City for more than 50 years, was a true pioneer of the western plains. Now, powered by oil-burning locomotives, it is a favored passenger train because of its rapid transportation, leaving St. Louis at 11:59 P.M. and arriving at Kansas City at 7:15 A.M. Good track, careful maintenance and every modern safety device is essential to reliable service. Like the *Missourian*, HY-CROME Spring Washers are dependable, efficient, economical and safe to rely upon.

EATON MANUFACTURING COMPANY

RELIANCE SPRING WASHER DIVISION

MASSILLON, OHIO

Sales Offices: New York, Cleveland, Detroit, Chicago, St. Louis, San Francisco, Montreal



THE PIONEER ROUND EDGE ALLOY STEEL STRAIGHT COIL SPRING WASHER

Published monthly by Simmons-Boardman Publishing Company, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, $2.00; Canada, $2.50; Foreign, $3.00. Single copies 35 cents. Entered as second class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

Why do Cars Skid?



THE answer is insufficient frictional resistance or inadequate tread design to resist the lateral forces.

You have similar conditions to combat in preventing the widening of track gauge.

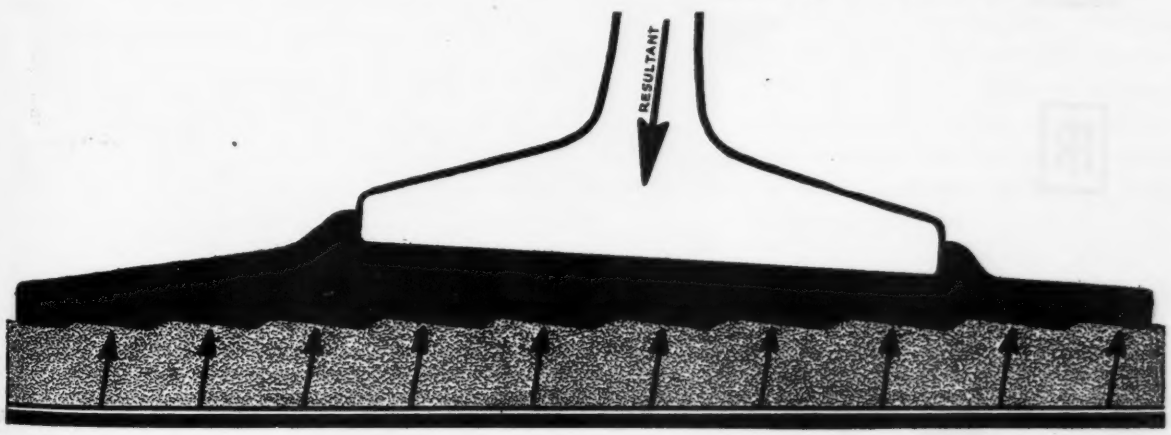
The Lundie Plate overcomes this scientifically by a base design which compensates for lateral thrusts, and without the use of any tie destroying projections. The multiple bearing areas of the Lundie base are normal to the resultant of the vertical and lateral loads on the tie. That's why there is no tendency to slip. Other base design plates can prevent spreading only by the use of tie destroying projections which gouge into the timber and cause both mechanical wear and decay.

The Lundie Plate holds gauge without cutting a single fibre of the tie. It assures maximum tie life and minimum tie costs.

The Lundie Engineering Corporation

Tie Plates—Ardco Rail and Flange Lubricator

285 Madison Avenue, New York 59 East Van Buren St., Chicago



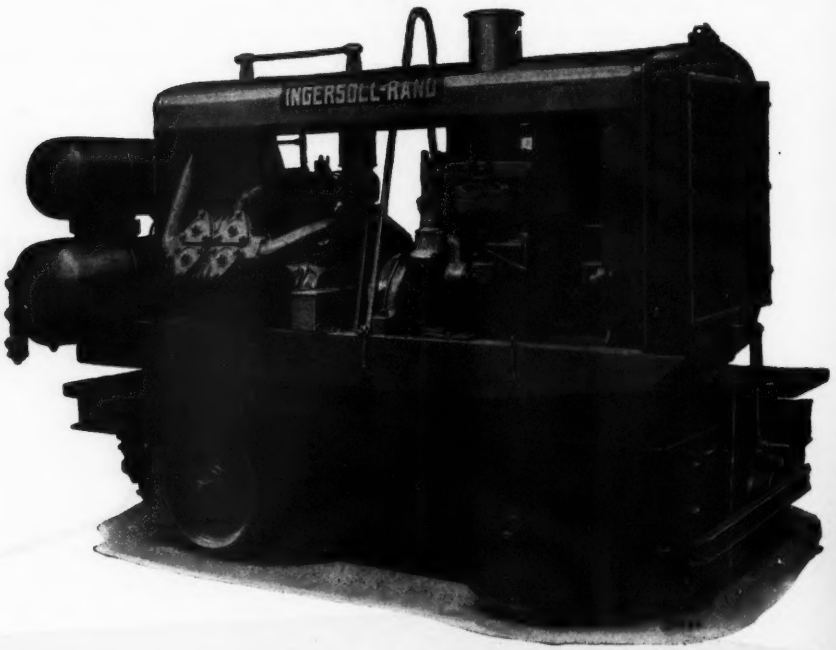


32736

The ECONOMY COMBINATION

of Two-Stage Air-Cooled Air Compressors and MT3 Low Air Consumption Tie Tampers

1. 23% More Air.
2. 25% Less Gasoline per cubic foot of air.
3. 20% Less Weight, for number of tampers or other tools operated.
4. Higher Sustained Efficiency.
5. Lower First Cost.
6. Lower Operating Cost.
7. Lower Maintenance Cost.
8. Operates a greater number of tie tampers or other tools than single-stage compressors of corresponding P. D. capacities.
9. Tie Tampers consume 24% less air.
10. Improved toothed-type tamping bars give increased footage.
11. Effect savings according to size and style of unit used ranging from $233. to $2539. per tamping season of 100 working days.
12. With MT-3 tie tampers you can get at least 33-1/3% more work for same amount of air or fuel consumed.



Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y.

30-11

THIS EMERGENCY REPAIR JOB

SAVED MONEY over alternate methods



CALL IN AN ARMCO ENGINEER

Under a main line railroad in Indiana, this old stone arch started to collapse. Trains were "slowed down" to 10 miles an hour. But the railroad engineers acted quickly—and wisely. They relined the failing structure with an Armco Multi Plate arch, set in grooves along the sidewalls.

Immediate economy resulted—with scarcely any reduction in the waterway area. Besides, Multi Plate can be counted on to give lifetime service, without further maintenance. Let an Armco drainage engineer discuss its application to your particular problems. Just write us.



Close-up showing strong, bolted construction of the thick pure iron plates.



Multi Plate is delivered "knocked-down" — ready for quick, easy erection.

★

INGOT IRON RAILWAY PRODUCTS COMPANY

(Member of the Armco Culvert Mfrs. Assn.)

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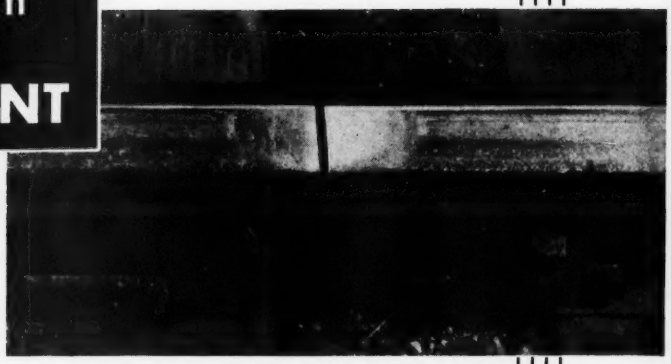
HEAT TREAT your RAIL ENDS

and make them last as long as the rails, with AIRCO EQUIPMENT

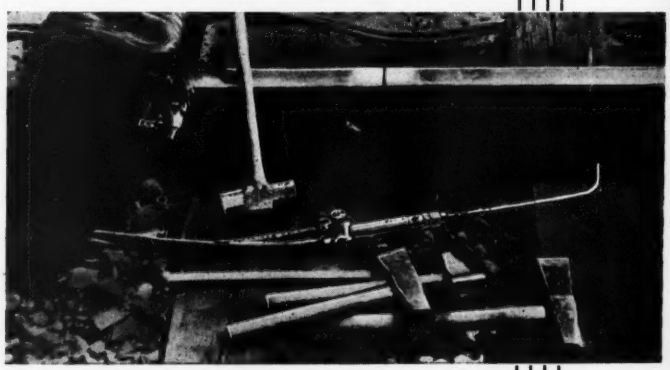
Heat treated rail ends are harder, tougher and better able to resist wear and pounding. Avoid batter in new rails by using the AIRCOWELDING process of HEAT TREATING the rail ends. It makes them good for the life of the rails.

Ends that are slightly battered, can be re-formed and then heat treated as the illustrations show. Ends that have reached the stage where building up is necessary, should be heat treated after rebuilding—and they will not have to be built up again. In short, *a sizable, chunk can be chopped off rail maintenance expense if every rail end is heat treated.*

AIRCO'S RAILROAD DEPARTMENT will be glad to cooperate with Maintenance of Way Departments in putting into practice this money saving process of re-forming and HEAT TREATING rail ends.



Close-up of the re-formed and heat-treated ends. Time (for both operations) 5½ minutes. Cost, approximately 35c



Here are the ends after re-forming and heat treating. Tools used in re-forming are shown



These rails are slightly battered but they were re-formed without welding, and no adding material was required

AIRCO DAVIS-BOURNONVILLE

AIR REDUCTION SALES CO.

General Offices: 60 East 42nd St. New York, N. Y.

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A Nation-wide Oxyacetylene Welding and Cutting Supply Service

Airco Oxygen—Airco Acetylene—Supplies—National Carbide—Airco-DB Welding and Cutting Apparatus



For that BALLASTING which has been left undone

That long delayed ballasting must eventually be done. To accomplish more work in less time with the least expenditure, a Nordberg Power Jack should be on the job. This jack and one man easily raises a mile of track a day. Seven thousand feet a day is not unusual. There is no delay to the tamping gang with a Power Jack on the job. If your ballasting has been deferred, this machine will enable the work to be done quicker and with the least delay to traffic.

There are seven other Nordberg Maintenance Tools just as useful in making your appropriation go farther.

NORDBERG MFG. CO.
Milwaukee, Wis.



Rail Grinder



Cross Grinder



Adzing Machine



Spike Puller



Rail Drill

TRACK MAINTENANCE MACHINERY

Atlacide Chlorate Weed Killer

Applied by diluting in water as a spray or directly as a dust

ATLACIDE packed in two hundred pound, one hundred pound and fifty pound drums has found many practical uses for incidental track weeding when distributed through section forces where spray train operation is not practiced. Weed patches occasionally occurring in the ballast or along the subshoulder can be quickly eradicated by using knapsack sprayers or dusters. Knapsack sprayers use two pounds of Atlacide for each gallon of water and can be used to cover considerable area with one man operation.

Chipman weed killing bulletins and personal service are available and inquiries are invited at our several railroad division offices in Houston, Texas; Palo Alto, California; Chicago, Illinois; Winnipeg, Canada and Bound Brook, New Jersey.

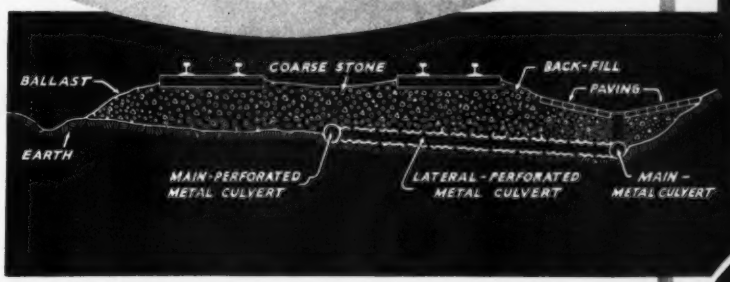
Chemical weed killer spray programs are now being made with maximum efficiency

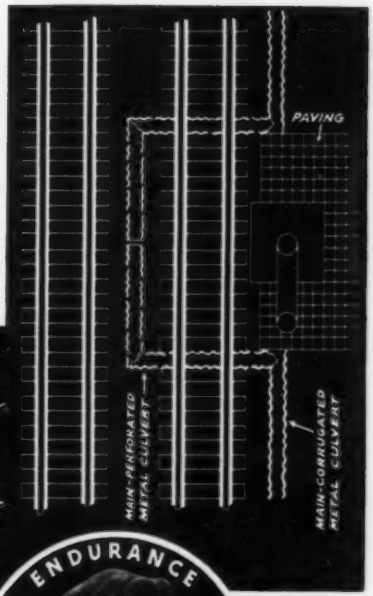
Chipman Chemical Company, Inc.

Bound Brook, N. J.

Chicago, Ill. Palo Alto, Cal. Winnipeg, Canada Houston, Tex. Kansas City, Mo. London, England

USE TONCAN CULVERTS FOR PROPER DRAINAGE AT WATER STATIONS







It is always difficult to dispose of surplus water at a water station. If proper drainage is not provided, excess water stands in the track, softening the sub-grade and causing a rough spot. In the winter, ice collects in and on top of the ballast, causing a dangerous condition.

Toncan Iron Culverts will prove a satisfactory solution for your problem. Place Perforated Toncan Iron Culverts under the track as shown in the accompanying sketch, just at the top of the sub-grade. Back-fill with coarse, clean stone. Construct a paved open ditch on three sides of the water station and drain this excess water into the side ditch mains. The side ditch mains should be Corrugated Toncan Iron Culverts. These mains may be connected to any convenient stream or adjacent sewer.

Toncan Iron Culverts, plain or perforated, offer an ideal solution for this and many other drainage problems. They are made of Toncan Iron—the alloy of refined iron, copper and molybdenum which is only excelled by the stainless irons and steels, among the ferrous metals, in its resistance to rust. This accounts for its longer life in service. It is also well known for its resistance to impact and vibration under heavy traffic. Consequently, it will last years longer than other culvert material only slightly lower in first cost.

TONCAN CULVERT MANUFACTURERS' ASSOCIATION

YOUNGSTOWN • OHIO

REG. U.S. PAT. OFF.
TONCAN
COPPER
MO-LYB-DEN-UM
IRON CULVERTS



TONCAN CULVERT RAILWAY SALES
218 South Michigan Avenue Chicago, Illinois



What do these facts mean to you—

MR. MANUFACTURER?

1. Railway traffic is increasing. Carloadings for 1934 to date exceed those for the same period of 1933 by 17 per cent. They are 3 per cent greater than for the first 16 weeks of 1932.

2. Net railway operating income is increasing at a still greater ratio. For the first three months of this year it was 2½ times that for the first quarter of 1933 and nearly twice that for the corresponding period of 1932.

3. Expenditures for maintenance of way and structures have exceeded those for the corresponding period of the previous year in every month except one since last June. The increase for the first two months of 1934, the latest for which figures are available, is 14 per cent.

4. The railways have ordered more than 630,000 tons of rails since last October. This is nearly twice the tonnage rolled in the entire year of 1933 and nearly equal to the combined output for 1932 and 1933.

5. Rail orders are recognized as a barometer for other maintenance of way expenditures. Orders for rails presage purchases of other materials and equipment.

6. The needs of the railways are so great that they cannot possibly purchase this year all of the materials that they require. Their problem is one of selection.

Are you presenting your story to the men who are preparing the programs for roadway and structures rehabilitation and selecting the materials needed therefor? In other words, will your products be near the top of the list?

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS



MADE TO ENDURE!

Not one year or two years, but many years of service on main-line, right-of-way constitute common performance for cast Manganese Steel Crossings. They are made to endure.

Manganese Steel generally outserves other metals in frogs, crossings and switches because of its outstanding resistance to impact and wear. It is a matter of common knowledge that it builds up increasing shock and wear resistance under successive blows.

AMSCO has served American railroads with Manganese Steel special track-work for twenty-five years through leading fabricators. The carefully controlled analysis and heat-treatment we employ have produced castings giving seemingly impossible service records.

To obtain the most in long life and economical maintenance —Specify AMSCO Manganese Steel, "The Toughest Steel Known," on your track-work orders.

Four crossings of four-piece reversible design are shown above, detail below. Installed three years ago, these crossings were recently reversed and promise many more years of service under extremely heavy traffic.



AMERICAN MANGANESE STEEL COMPANY
Subsidiary of The American Brake Shoe & Foundry Co.
398 East 14th Street
Chicago Heights, Illinois.

AMSCO

No. 65 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: A Broader View

April 26, 1934

Dear Reader:

"Why do you always devote your leading editorial to some broader phase of railway public relations when you confine the remainder of your issue so consistently to the more specific problems of roadway maintenance?" This was a question put to me a few days ago. It is a logical question and entitled to an answer.

Railway Engineering and Maintenance is edited, as you know, to aid you in your daily work of building and maintaining the tracks, bridges, buildings and water service facilities that comprise the fixed properties of the railway. We seek to present within its pages information that will be of the greatest practical assistance to you in your daily work.

Of late years, however, it has become apparent that there rests on every railway employee the added obligation of so presenting the facts regarding the railways to those with whom he comes in contact that these persons will be correctly informed and encouraged to advocate fair treatment for the roads. This requires that each employee be conversant with the facts himself.

It is my belief that few employees have greater opportunities to disseminate such information than the maintenance man, for whether he be division engineer, supervisor or foreman, his work brings him in contact not only with the owner of property adjoining the right of way but with many patrons of the road, as well as with residents of communities along the line. It is to provide you with information for dissemination among these persons that our lead editorials are prepared.

That these editorials are serving their purpose is indicated by the appreciative letters that we are receiving in increasing numbers. Typical of these is a letter received a few days ago from a supervisor on a western road who described the effective use that he was making of the editorial in the last issue entitled, "What Happens When a Railway Leaves a Community?" in talks with shippers and residents along his line. Similarly, a supervisor on a prominent eastern line told me that he had prepared a paper on bus competition from editorials in earlier issues and that his audiences "seemed to eat it up."

This is our reason for a "public relations" editorial in a maintenance of way magazine. The extensive use that is being made of this information appears to us to justify its presentation. Incidentally, the use that is being made of this information by so many of our readers suggests a service that others may render their roads.

Yours sincerely,

Elmer T. Howson

ETH*JC

Editor

MEMBER: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

PUTTING THE BRAKES ON RUST...



Dutch Boy Red-Lead is a highly oxidized red-lead supplied in two forms — paste and liquid. The paste comes in natural orange-red, is readily mixed to brushing consistency, can be tinted to darker colors. Dutch Boy Liquid Red-Lead (ready for the brush) comes in the natural orange-red, two shades of brown, also in black.

Nothing protects metal like Red-Lead and "Saucer Test" proves it

ARE YOU one of those responsible for the care of iron and steel structures? Are you connected with a steamship company, a railroad, an oil or gas company, a highway department or any other organization with large areas of metal to be kept in A-1 condition?

It is for men in your position that we have developed the "Saucer Test", a simple, practical way to demonstrate which paint gives metal structures the most durable and economical protection.

The "Saucer Test" Kit comes to you free . . . just send coupon below. Includes metal saucer and sample of Dutch Boy Red-Lead to test against any other paint you wish. Choose your own conditions. Test under sun, heat, cold, moisture, smoke, fumes, salt air, water.

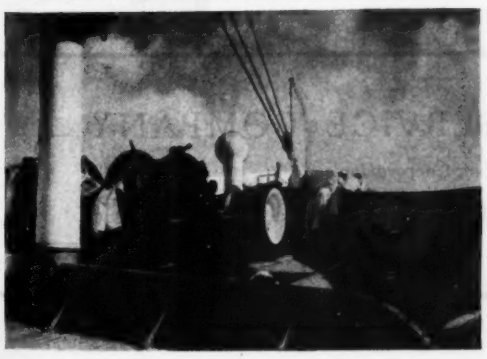
In a long series of tests conducted by a leading southern railroad, the "Saucer Test" proved that pure red-lead outlasted other paints tested as a primer by 4 to 1.

But don't take our word for it or the word of others. Put red-lead *on the spot* yourself. Send for the KIT and see the evidence with your own two eyes . . . how pure red-lead gives long-life protection and saves money.

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111 Broadway, New York; 116 Oak St., Buffalo; 900 W. 18th St., Chicago; 659 Freeman Ave., Cincinnati; 820 W. Superior Ave., Cleveland; 722 Chestnut St., St. Louis; 2240 24th St., San Francisco; National-Boston Lead Co., 800 Albany St., Boston; National Lead & Oil Co. of Pa., 316 4th Ave., Pittsburgh; John T. Lewis & Bros. Co., Widener Bldg., Philadelphia.

DUTCH BOY RED-LEAD





NATIONAL LEAD COMPANY

Please send *free* kit for making the "Saucer Test" REM-5-34

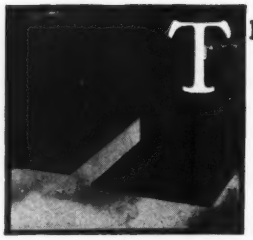
*Individual's Name and Title*_____

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Thirty Cents of Every Track Maintenance Dollar



THAT'S how much goes into upkeep of rail joints.

To reduce this cost two things are needed—a good way to retard rail end batter, and a good way to repair this defect if it occurs.

The Oxweld Railroad Service Company furnishes both of these. The Oxweld Process of hardening rail ends by heat treatment gives greater wear resistance at the point of impact, at a cost of only a few cents per joint, or a few dollars per mile.

Building up worn rail ends by oxwelding provides a prompt, easy method of repairing the damage done. The cost is remarkably low.

The Oxweld Railroad Service Company has a highly trained force in charge of their Track Department that has specialized in railroad track maintenance for a number of years, which, with the assistance of a splendid laboratory personnel, has developed methods for performing these as well as innumerable other applications of the oxy-acetylene process. This service is promptly available to contract customers exclusively. The majority of the Class I railroads have for many years been relying on this source, not only for engineering assistance and instruction, but also for the quality materials and apparatus necessary for this work.





THE OXWELD RAILROAD SERVICE COMPANY

Unit of Union Carbide and Carbon Corporation

NEW YORK: Carbide and Carbon Bldg. UCC CHICAGO: Carbide and Carbon Bldg.





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58 Main Street



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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

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ELMER T. HOWSON
Editor

WALTER S. LACHER
Managing Editor

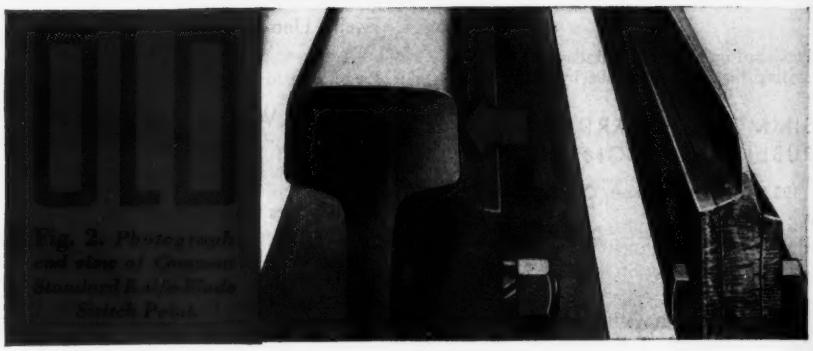
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THE RACOR SAMSON SWITCH POINTS*

with no extra cost . . .
assure remarkable economy and added safety

WHEN considering switch points take into account that the Racor Samson Switch* means no more short life of switch points . . . no more broken down switch points . . . no more need of switch point protectors.

Samson Switch Points maintain necessary wearing surfaces to engage wheel flanges for a smooth safe passage; with them there is no danger of wheel flanges mounting on jagged wearing surfaces; they give many times the life of common standard knife-blade switches. There is probably no recent innovation in trackwork that will give a greater return on investment than the Racor Samson Switch.*

Its remarkable length of life is assured by the inverted 'V' shape of the point that fits against the undercut stock rail as shown in Fig. 1 . . . It wears smoothly and WILL NOT BREAK DOWN.

Switch points, plates and rods cost no more than old standard equipment. The cost of the stock rails, machined as illustrated in Fig. 1, is negligible when compared to increased service life. Machined stock rails can be purchased with the switch; or, if preferred, they can be satisfactorily milled in the field with a portable milling machine, operated either electrically or pneumatically from air brake pressure cylinder.

Many large railroad systems in Continental Europe have adopted universally similar switch point planing. Also many large systems in the U.S.A. have installed the Samson Switch with proof of the above claims.

For further information write your nearest Ramapo plant or office.

*While covered by United States patents, all the larger manufacturers specializing in trackwork in this country have licenses to furnish the Samson Switch.

RACOR



Railway Engineering and Maintenance



SCHOOLS

Railway Taxes Educate Many Pupils

THERE was a time when the railways were regarded as "foreign" corporations, directed by officers at remote headquarters with little regard for or interest in the local communities served by their lines. More recently this attitude has changed, largely through the efforts of employees resident in these communities in acquainting their neighbors with the mutuality of interest prevailing between the railways and those whom they serve.

In this educational activity, much emphasis has been placed on the importance to the community of the transportation service rendered by the railways. Likewise, the importance of the railway payroll to the commercial life of the community has been stressed. There is still another relationship, however, that brings the railways into an even more intimate relationship with the residents of every local community. This is the very substantial support which the railways give to the public school system through the taxes which they pay for this purpose.

The Public School

No public institution comes closer to the average citizen than our public schools. Likewise, no institution is more carefully guarded. The school house is to be found wherever people live, no matter how remote from the centers of population. The support of our public schools is a responsibility of our local governments. They must provide the money necessary to place the advantages of a common school education within the reach of every child. This activity holds first claim on public funds.

Little thought is given by the average citizen to the source of this money other than it comes from some indefinite reservoir of taxation. It will be enlightening to the average citizen, therefore, for employees of the railways to show him how large a part of the support of the public schools comes from the railways.

Railways Are Taxpayers

The railways are among our largest taxpayers. In 1921 the expenditures for taxes by all the railways in the United States reached the high total of $419,179,204 or nearly $1,500,000 every working day. Even in 1932, when the railways handled only slightly more than half the traffic of 1929 and when they failed to earn their fixed charges by $153,308,487, they paid $292,709,232 in taxes for the support of the federal, state and national governments, or approximately a million dollars a working day.

In this latter year, incidentally, the railways paid 78 cents in taxes for every dollar they expended for the maintenance and upkeep of their roadway and structures. In this year also, they paid nearly three times as much money for taxes as they did for dividends to their stockholders. The magnitude of these payments is shown also by the fact that taxes took 8.8 cents of every dollar which the railways received in 1932, the largest proportion ever taken.

Railroads Support Schools

Of these payments, somewhat more than 95 per cent (95.5 per cent in 1932) go for state and local governments, while less than 5 per cent go to the federal government. Classified in another way, approximately 45 per cent (45.8 per cent in 1930-31) of the total tax payments of the railways go for the support of the public schools, this being by far the largest single item in their tax bill. In the years referred to, this proportion for school purposes totaled $148,041,456 annually, or nearly a half a million dollars per working day.

Of what effect is this expenditure? Let us look to the Office of Education of the United States Department of the Interior for the answer. According to information from this bureau, the average expenditure on public elementary and secondary schools in 1930 amounted to $90.22 for every pupil enrolled. This figure included expenditures for new buildings as well as for operation and equipment.

Children Educated

On this basis, the payments made by the railways for school purposes, as quoted above, were sufficient to defray the cost of schooling for 1,640,894 pupils, or more school children than are in all of the 11 states west of the Dakota-Nebraska-Oklahoma-Texas line except California. In other words, the taxes paid by the railways for school purposes are sufficient to provide common school education for all of the children in the states of Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Idaho, Oregon and Washington. Considered locally, the taxes paid by the railways in the state of Illinois for the support of the public schools alone were sufficient to defray the expense of providing schooling for 98,389 pupils; in Michigan, 86,452 pupils; in Ohio, 80,647 pupils; in New Jersey, 79,210 pupils, etc.

This is the contribution which the railways make to the support of the country's most basic institution. It is a contribution which the public should know about. It is a contribution which is made possible only by the patronage which the public gives the railways, as many communities are now finding to their sorrow when the railways abandon their lines and leave these communities to the bus and truck lines to whom they have thoughtlessly diverted their patronage. When this crisis confronts a community, as it already has in many, it not only deprives that community of the dependable transportation service which it has all too frequently taken for granted, but also removes a major source of support for its public schools, which must be made good by increased taxation on the property remaining.

TERMITES

A Little Known Enemy of Wood

FEW railway men in charge of the construction and maintenance of railway bridges and buildings are familiar with termites, the character of their destructive work and the methods for the control of these insects which are destroying thousands of dollars worth of wooden structures annually, particularly in the southern states and along the Atlantic and Pacific seaboards. This lack of familiarity with termites constitutes little reflection on these men for a number of reasons. In the first place, there has been relatively little information published concerning these insects. This is not because termites are new or have not been continuously at their destructive work in many parts of the country for years, but rather because of the secretive manner in which they work and the general lack of recognition of the damage which they cause.

Working wholly within the timber in highly organized and efficient colonies, except during relatively brief periods of swarming, termites carry on their destructive work unobserved and secure from the attack of most of their enemies. They can be found only by diligent inspection of trained eyes, and even the devastation which they cause usually passes undetected until the structure fails. Further obscuring the damage done by these insects is the fact that termite attacks are frequently confused with dry rot.

Another important reason for the lack of detailed knowledge among railway men concerning termites is the fact that the timber structures built by the railways are increasingly of treated timber and properly handled. These measures are the best safeguard against termite destruction and their widespread adoption by the railways is undoubtedly the principal reason why termite damage has not yet been considered to be a serious problem on the railways except locally in those territories which are subject to the greatest termite activity.

That there has been more destruction of railway structures by termites throughout the country than is generally appreciated, however, is evidenced by the report on termites and termite control which has just been published in book form by the Termite Investigation committee, a representative group of architects, engineers and large users of wood, working in co-operation with the University of California. In a portion of this report dealing specifically with railway pole lines, bridges, and other structures, prepared under the direction of W. H. Kirkbride, chief engineer of the Southern Pacific, Pacific System, the importance of termite investigation to the railways is emphasized.

Those railway officers who have given this subject the closest study have generally found that more damage has been done to railway structures than has been recognized and reported. The menace is so great that such large users of timber as the railways, especially in so many structures where integrity of strength is a primary consideration, cannot afford to disregard the increasing activity of termites and the growing threat that this holds for timber structures. It would appear essential, therefore, that railway construction and maintenance officers concerned with the use of timber on the railroads should familiarize themselves with termites and the nature of their attacks in order that they may be able to check their activity and take all reasonable precautions in construction and maintenance to protect their structures against the attack of this insect. The article by Dr. Hermann von Schrenk that appears on page 269 of this issue will be helpful in this connection.

CENTER-BOUND TRACK

No Other Remedy Than a General Surface

IT would be difficult to commend too highly maintenance officers and men alike for the splendid record they have made in keeping the main tracks in good riding condition during the period of constantly shrinking appropriations from which we are now emerging. Yet, because so high a degree of success has been attained in this respect, the necessity for continuing some of the practices that were formerly considered fundamental may not seem so impressive now as it did four or five years ago.

With minor exceptions, main tracks have not been given a general surface for four years and much of this trackage had not been surfaced in this manner for several years prior to 1929. As a result, probably no maintenance officer in active service can remember when so large a percentage of the main track of the country has been carried for such a long period without being given this treatment.

In view of the success that most roads have had in maintaining smooth track for so long a time without a general raise, some officers are beginning to suggest that the practice that was forced on them can be continued for a still longer time. Doubtless, under some conditions it can. The greater activity in cleaning ballast that has developed on many roads as equipment for this purpose has become available, will tend to increase somewhat the intervals between light raises and more particularly the periods between general ballast renewals.

There comes a time, however, depending on many factors, but mainly on the kind and depth of the ballast and the volume and character of the traffic, when there can be no substitute for a light general raise if smooth track

is to be maintained. In some kinds of ballast this interval is short; in others it may be relatively long. After track has been maintained by routine surfacing for about so long, however, whether it is tamped by hand or mechanically, it tends to become center bound, the consequences of which are all unfavorable to good riding.

It has been the practice on most roads to give the track a light general surface, raising it from 1 to 2 in., about once every four years, this interval depending on the factors already mentioned. To avoid duplication of effort, tie renewals are usually made as the surfacing progresses and the track is left in a condition which requires only minor attention for the first two years thereafter. In this way, the benefits accruing from the added labor that is applied to the track are spread over a considerable period and the extra cost involved is, in effect, distributed over a like period.

At this time, so many items of maintenance that have been deferred are demanding attention that, even in the face of increased expenditures, maintenance officers are still confronted with the necessity of distributing their appropriations in such a way as to obtain the largest return on the money they can spend, rather than to do their work in the orderly, systematic way they would like to. Many roads will renew a considerable mileage of rail this year, and it is obvious that the track involved in these renewals will be given a general surface to protect the new rail from damage. But there will still remain many miles of track that need the same attention, on some of which the rail already in service is likely to be damaged if this attention is not given. It appears, therefore, that maintenance officers should consider carefully whether they can justify a continuation of the surfacing methods of the last four years, particularly on track that is already center bound or is likely to become so if it is not given a light raise at this time.

HIGHER SPEEDS

What They Mean to the Track

FORTY-ONE years ago, the Empire State Express, hauled by the famous "999," attained a speed of 112½ miles per hour. However, this and other fast runs made by trains and locomotives of the conventional type, were conducted under special circumstances or for purposes of test. The speeds of trains in regular operation have lagged far behind these extraordinary records, and such general increase in train speeds as has taken place through the years has been very gradual. It was not until the advent of such trains of radically new design as the new aluminum train of the Union Pacific, and the still newer stainless steel train of the Burlington, that any serious attempt has been made to attain in regular service, speeds heretofore realized only under special conditions, and to do this by a single bold step.

What bearing does this contemplated increase in train speed have on track construction and track maintenance? True, the new idea in train design and operation has been fostered by only two roads as yet, but it is gaining acceptance elsewhere and it will not be long before the maintenance officers of other roads will be required to answer this question. They have, of course, been confronted with the effect on tracks resulting from the movement at much higher speeds than formerly, of locomotives and cars that are much heavier than the lightweight, superspeed trains that are now being introduced. Therefore, so far as wear and tear on the track are concerned, the newer trains are not expected to introduce any serious problem.

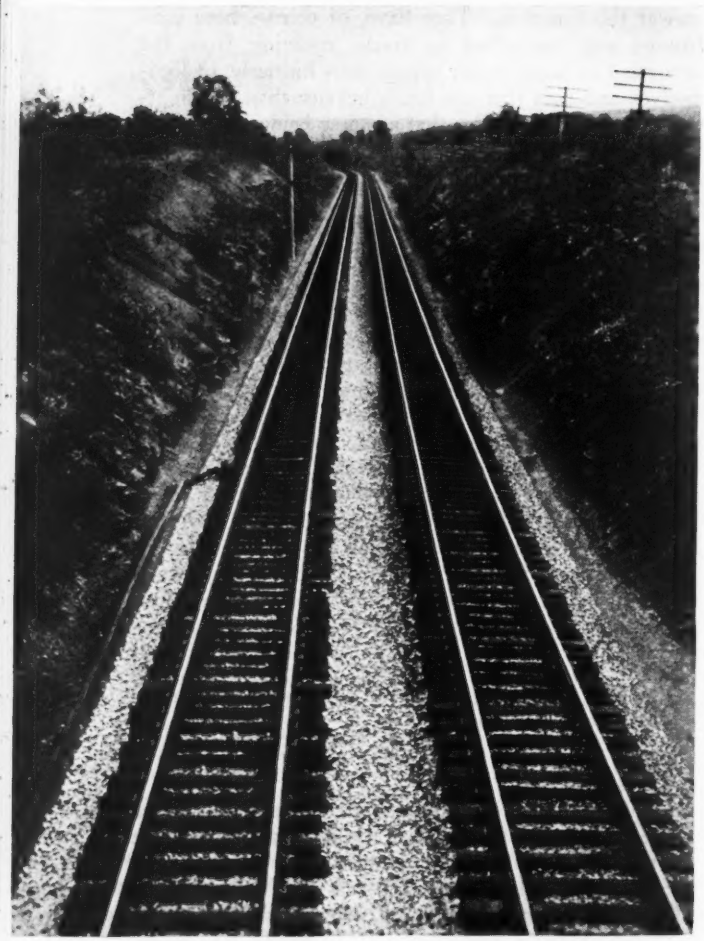
When, however, the situation is presented from the other side, namely, the influence of the track on the successful operation of the superspeed trains, the answer is not so conclusive. The designers of the new trains have proceeded on the assumption that weight is not essential for comfortable riding, and test runs demonstrate that light equipment on specially designed, four-wheel trucks can be made to ride as easy as heavy cars on six-wheel trucks. But no car, no matter how skillfully it has been designed, will ride well on track that does not possess good surface and line. Any irregularity in track, such as a slight kink in line through a turnout or a crossing, has a much greater effect on a train traveling at 90 miles per hour than at 50 miles per hour. The lengths of easement curves, the alinement on curves and the amount and uniformity of superelevation, are likewise more important, and whereas the question of the most satisfactory superelevation on a curve that handles trains at 60 miles per hour in one direction, and at 15 miles per hour in the opposite direction is a perplexing one, it becomes a matter of even greater difficulty when the variation in speed is doubled.

While the condition of the track is paramount when viewed from the standpoint of riding qualities, because the new trains will not be a success unless they provide a comfortable ride as well as a fast one, the matter of safety is even more important. In general, track that rides well at high speeds, should also insure safe operation, so far as the physical structure is concerned. But the responsibility of the track forces does not stop there, since the human factor must also be considered. In view of the fact that the probable consequence of derailment following a highway grade crossing collision at the higher speeds interposes the one discordant note in the general enthusiasm for this new form of rail transportation, it is well for maintenance men to keep before them the dire potentialities of derailments from any cause whatever. The inauguration of the higher speeds on any line will require a tightening up of discipline in the conduct of all operations on tracks and bridges, not only because of the more serious consequences of a derailment at higher speeds, but also because higher speeds will demand greater vigilance in getting men, tools, track materials and motor cars in the clear. No less important is the necessity for the utmost care in the maintenance of switches, switch stands, etc. The record train speeds of years gone by were obtained under special conditions, with the switches spiked; the new trains must be operated with equal safety as a matter of daily routine.



Sound Roadbed P

That adequate subsurface drainage systems may be a means of maintaining the roadbed in good condition through a period of restricted maintenance expenditures is demonstrated on the Lehigh Valley where approximately 100 miles of subsurface drains are in service. Embankment wash and erosion have also presented a serious problem and to correct this condition this road has placed 500,000 cu. yd. of heavy riprap. The methods followed in carrying out these maintenance functions are described in this article.



Subdrainage Under Both Side Ditches in this Narrow Shale Cut Solved a Serious Wet Roadbed Problem

IN spite of large and consistent reductions in maintenance of way and structures expenditures on the Lehigh Valley since 1926, the tracks and roadbed of that road are still in remarkably good condition. This healthy situation is not the result of ideal natural conditions, but, on the contrary, is due largely to an early conceived and wisely executed struggle against severe natural conditions.

Much has been said about Lehigh Valley track construction, with its 136-lb. rail, large treated cross ties, heavy tie plates, etc., but one has been left largely to assume that the natural roadbed of this road is ideal or, at least adequate in itself to support this heavy construction and the loads imposed upon it. The fact is that nothing could be farther from the truth on a large part of the line, which would be ravaged yearly by high river waters and be pumping continually in mud if it were not for the extensive remedial measures which have been taken to protect embankments and to subdrain the miles of naturally unfavorable sub-soil encountered. That there exists a naturally adverse condition, and that this has been attacked on a large scale, entirely aside from sizable yearly programs of ditching and cut widening, is seen in the fact that approximately 100 miles of subdrainage has been installed on 447 miles of main line, on one or both sides, and also in the fact that approximately 500,000 cu. yd. of riprap have been placed on the slopes of embankments along the Lehigh and Susquehanna rivers, between Easton and Sayre, Pa.

The poor sub-soil conditions, while scattered over the entire road, are most severe east of Mauch Chunk, Pa., and especially through New Jersey where a fine red clay is encountered which puddles readily, even where there appears to be normal surface drainage. The worst drainage difficulties have been encountered in cuts, and especially in the many soft rock cuts in New Jersey. In many of these cuts the condition was aggravated by the fact that the cuts are relatively narrow, having been so provided initially to minimize construction costs and having remained so because of the large expenditure necessary to widen them. As a result, the side ditches in these cuts lie immediately adjacent to the ballast shoulders and are severely restricted in width. In most of these cases the ditches remained dry most of the time, but, in spite of this, the clay subgrade remained wet and worked its way up through the ballast, causing soft spots and necessitating a continuous round of maintenance to keep the tracks in good line and surface.

The Lehigh Valley early recognized that even the most substantial track construction loses much of its advantage on a poor foundation, and that deep ballast of the best quality is an expensive and only temporary remedy for soft spots. As a result, its drainage work has not been of recent origin, having been started on a large scale as early as 1910. By 1926 approximately 75 lineal miles of sub-drainage lines had been installed, mostly of field or vitrified tile, while since that year, approximately 25 lineal miles of additional drainage has been installed practically all of Armco and Toncan corrugated and perforated metal pipe.

Installation Relatively Simple

There is little of the spectacular in what the Lehigh Valley has done or in the methods it has employed. The main point is that it early recognized its problem and has met it through a persistent attack, even though many of the benefits resulting have been difficult to calculate or have been attributed to some other factor of improved track construction or maintenance.

With a double-track main line throughout, except for about 25 miles of four track line in Pennsylvania and New Jersey, about 95 per cent of the subdrainage

Pays Its Way

on the road consists of single lines of tile or pipe underlying the side ditches. The remaining subdrainage, which is largely in the four-track territory, consists of lateral and inter-track drains, designed to tap the sub-surface water directly beneath the tracks. Each installation was based on the particular conditions encountered, with only a few generally applied standards, such as the character of the pipe used, the character and depth of back-fill, and the minimum rate of fall. As a matter of fact, even these standards were deviated from where conditions did not warrant or permit their adoption.

In 1926 the use of tile pipe for sub-surface drains was discontinued and corrugated metal pipe in 20-ft. lengths, and mostly 6 and 8-in. diameters, was adopted. All of the latter pipe has been of 16-gage material, with band-type joints, and perforated in its lower half to permit the ready infiltration of water. The extent of the individual installations varies from those with 100-ft. of pipe or less, to those extending over a mile in length and involving one or more lines of pipe, with or without lateral drains.

A minimum fall of 2 in. in 100 ft. has been adhered to, and the pipe has been placed below the frost level wherever possible. The long drainage lines, especially in level track territory, are essentially a succession of separate installations, with the pipe extending each way from high points to catch basins and outlets at low points. Wherever possible, a fall of at least 3 in. in 100 ft. has been afforded to increase the rate of flow in the drains and thereby minimize the accumulation of sediment in them, and a minimum cover of at least 18 in. has been provided over the pipe.

Where there was any perceptible fall in the ditches themselves, these requirements have been met readily,

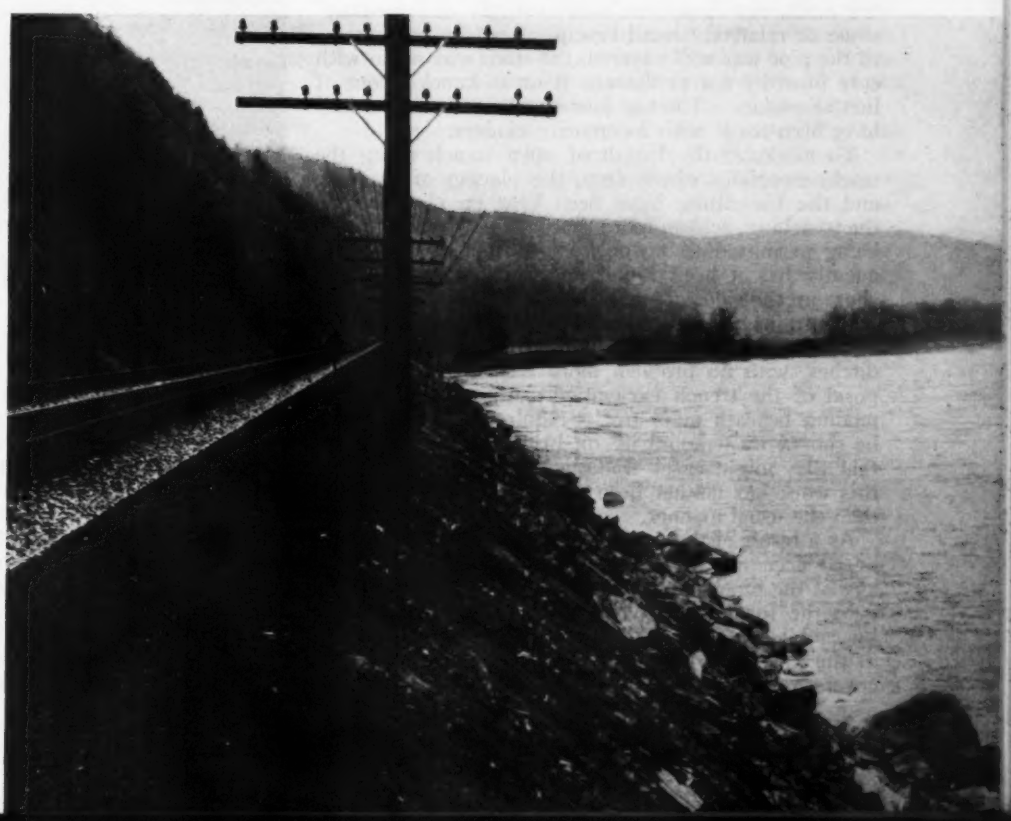


Installing Eight-Inch Corrugated Iron Pipe in a Narrow Cut

the most serious obstacle being the encountering of rock, especially in the flatter ditches. Where rock has been encountered, it has frequently been found advisable to limit the depth of installation and also the rate of fall, to preclude expensive hand excavation. This has not been considered disadvantageous, because the presence of rock, especially in cuts, indicates the level below which drainage is not necessary.

As a general rule, the ditch subdrains have been installed just beyond the ends of the ties, beneath the outside ballast shoulder, or as close to the track as possible. As a matter of fact, in many of the narrow cuts with narrow side ditches, any other location would have been impossible.

Practically all excavation for the pipe installations



Heavy Riprap (Partially Covered With Cinders) Protects the Roadway For Miles Along the Susquehanna River

has been done with picks and shovels, beginning in each case at one of the low points in the line in order that the trench would be self-draining as the work progressed. In this work, the shoulder ballast has been carefully laid up on the track where it could be retrieved later for use, and the remaining material excavated has then been piled along the outer side of the ditch for disposal later by locomotive cranes with clamshell buckets.

From stationing and elevations established by the division engineering corps and marked on stakes or on the rails at intervals of 25 ft., the ditching forces have



Back-Filling the Pipe Trench by Hand with Riprap

determined the depth and grade of the drain pipe, using the top of rail as a bench at each station and a track level to carry this datum level out over the center line of the pipe trench. With the base of the trench established, enough of the old shoulder ballast has been spread over the bottom to form a three to four-inch foundation for the pipe. The pipe has then been set in place, perforations down, and enough more of the old shoulder stone placed in the trench to bring it well up around the sides of the pipe. The cover over the pipe, up to within four to six inches of the flow line of the ditch, has then been made entirely of "one-man" stone or relatively small riprap, placed by hand. Until the pipe was well covered, the stone was set in with care in order not to damage it or to knock it out of line or surface. The top four to six inches of backfill have been made with locomotive cinders.

To minimize the length of open trench along the track, especially where deep, the placing of the pipe and the backfilling have been kept up close behind the trenching, seldom more than 50 to 100 ft. of trench being permitted to be open at a time. Only infrequently has it been found necessary or advisable to shore up the sides of the trench.

Subdrainage lines between tracks have been installed in much the same manner as those beneath the side ditches, with no problem more serious than the disposal of the trench excavation. All lateral lines extending beneath main tracks required that the tracks be shored up temporarily on bridge timbers in order that they might carry traffic without interruption, but this work has neither been difficult nor done in other than the usual manner.

As a result of the care exercised in installation, little or no accumulation of silt or debris is evidenced in any of the pipe installations made in recent years, and even the former difficulty with pipe stoppage caused by rabbits or other field animals building their nests in the pipes has been overcome by wiring perforated covers over the pipe outlets.

While carried out under system authorization, all of the drainage work has been planned and executed under division direction, much as in the case of tie renewals. Each year, the track supervisors and division engineers have set up ditching and drainage programs based on their intimate knowledge of conditions, and have submitted these to the chief engineer maintenance for approval. With authorization, schedules have been set up and detailed plans made for carrying out the work.

All of the work has been done by the regular section forces, and, while a certain amount has been distributed throughout the year to meet special conditions, the greater part has been done during the winter months to prevent interference with strictly spring, summer and fall work, and, at the same time, to afford constructive work for the men during the winter. Experience has showed the subdrainage work to be highly suited to the winter months on the eastern half of the road, the worst conditions encountered being a few inches of frozen ground which was readily broken through, and short periods of unusually severe weather when it became necessary to suspend operations temporarily.

Gangs of 12 to 14 men, not including foremen, have been employed in most of the work, aided by one or more locomotive cranes, usually without a work train. The cranes, equipped with special ¾-yd. clamshell buckets, 34 in. wide, have been used essentially in disposing of the material removed from the ditches in installing the pipe, but they have also served in shifting the care of pipe and of stone and cinders used in the back-fill. In most cases it has been possible for the cranes to cast the waste material over the tops of cuts or on to other parts of the right-of-way, to be leveled off later, but at times, because of high or steep banks,



Crane and Clamshell Disposing of Waste From Pipe Trench While Men Dress Up Ditch With Shovels

it has been necessary to load the material into cars attached to the cranes. Only infrequently have the cranes been used in excavating any part of the pipe trenches because of the relatively narrow trenches necessary for the installation of the pipe sizes most commonly used. They have been, however, used to good advantage in a number of cases in digging open drainage ditches.

In the usual size gangs, 8 to 10 men have generally been employed in digging the trenches and in installing the pipe, while four men were employed with the crane in unloading the pipe, riprap and cinders, and in cleaning and dressing up the ditches. Only infrequently has it been necessary or advisable to secure full use of the track or to use work train service to

carry out operations, this only when two or more cranes were used and when the site of the work was distant from a siding or other track on which the cranes could get in the clear.

A complete record of each pipe installation is kept in the office of the division engineer, being entered on a blue-print track-drainage chart. On this chart, red lines, with mile-post plusses at each end, indicate the exact location of each installation, and directly adjacent is given the date of installation, sizes of pipe installed, and the drainage pitch.



A Bad Spot Along the Lehigh River, Now Protected by Riprap

Miles of Banks Riprapped

Until corrected in the years 1926 to 1928, embankment wash and erosion by the Lehigh and Susquehanna rivers was just as serious a problem on the Lehigh Valley as wet roadbed, and frequently much more serious. Almost yearly with the high flood stages of these rivers and some of their tributaries, washouts occurred, not infrequently damaging hundreds of feet of track and halting or seriously interfering with traffic. Ice scour also presented a problem along the Susquehanna river.

While this condition had been treated locally from time to time, damage occurred yearly, until in 1926, when unusually heavy damage was sustained, it was realized that only a major riprapping program would be adequate to meet the situation successfully and permanently. In that year the road purchased fifty 30-yd. Clark air-operated side-dump cars and started a program of riprapping which resulted in the placing of approximately 500,000 cu. yd. of riprap. At many points the embankment was given protection out-of-face, and no point was overlooked which had already given trouble or which seemed likely to give trouble in the future. As a result, the washout problem was solved completely and the yearly expense of rebuilding sections of the roadbed and tracks has been wiped out.

Furthermore, the bank protection has greatly stabilized the roadbed at the former points of wash, which has been reflected directly in reduced track maintenance costs.

The riprap used was largely of hard limestone in pieces weighing up to 10 tons each. All of this was secured without cost from coal stripping operations at Hazelton, Pa., where it was loaded free on cars by the 100-ton electric crane of the coal company. As loaded, from 20 to 30 cars at a time were hauled out on the line and dumped. Any accumulation on the roadbed shoulder was plowed off with a Jordan spreader.

The riprapping program, as in the case of the subdrainage work of recent years, was carried out under the general direction of G. A. Phillips, then chief engineer maintenance of the Lehigh Valley and now chief engineer of the Delaware, Lackawanna & Western, and was in direct charge of the division engineers of the different divisions.

Motor Car Collision Caused by Defective Line-Ups

VIOLATION of rules governing the use of train line-ups by a tower operator and also to a certain extent by an extra gang foreman were mentioned as contributory causes of a fatal head-on collision between two motor cars on the Erie on September 1, 1933, in a report on the accident by the Bureau of Safety of the Interstate Commerce Commission. The accident resulted in the death of a signalman and a trackman and in the injury of five trackmen. The following facts are abstracted from the report of the Bureau of Safety.

The accident occurred in double-track territory equipped with centralized traffic control on the Delaware division of the Erie near Westcolang, Pa., the collision taking place on a 3-deg. 43-min. curve. Involved in the collision were an eastbound section motor car hauling two trailers carrying 49 trackmen, which was in charge of an extra-gang foreman, and a westbound section motor car carrying a signalman and his helper.

A few minutes prior to the accident the extra-gang foreman, whose motor car was traveling east on the eastbound track, had transferred his car and trailers to the westbound track in order to avoid a following train. He testified that before making the transfer he had obtained a train line-up from the tower operator, but had not filled out the usual line-up form as he had exhausted his supply of blanks and in addition felt that a written line-up was unnecessary as there was only one train against him. The signal helper testified that the signalman had obtained a line-up from the same operator about two minutes after the latter had talked to the extra-gang foreman but that no mention was made of the presence of the extra-gang motor car in the district.

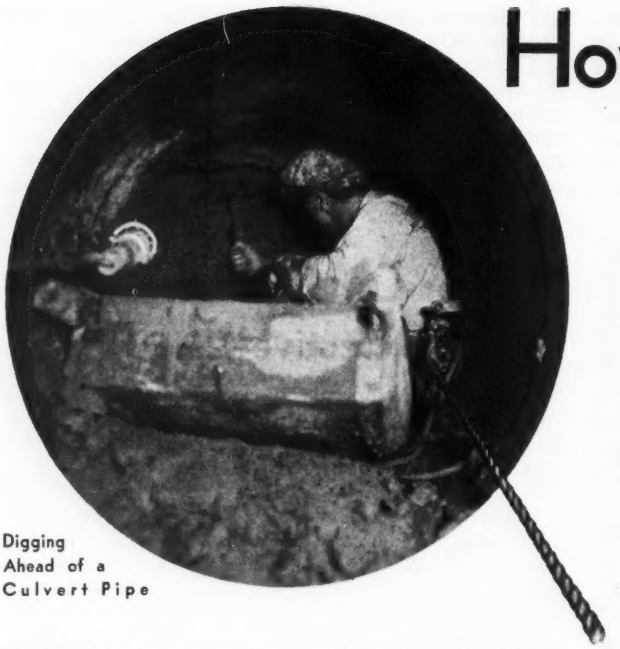
In the conclusions of the report it is stated that both the operator and the extra gang foreman ignored the following safety rule of the railroad governing the operation of motor cars.

> Employees in charge of such cars must obtain a train line-up (preferably in writing), originated by the train dispatcher, giving all the train and motor cars operating in a specified section during a certain period * * *

Responsibility for the accident is placed largely on the shoulders of the tower operator for exceeding his authority in issuing the line-ups to motor cars and for not being specific in his instructions to the extra-gang foreman. However, part of the blame is placed with the extra-gang foreman for violating the above rule and for ignoring another rule which states that "permission must be obtained from the train dispatcher when circumstances demand operation against traffic."

FREIGHT LOADING.—Revenue freight carloadings for the week ending April 14 totaled 578,837 cars, an increase of 20,950 cars above the preceding week, 80,655 cars above the same week in 1933, and 12,011 cars above the corresponding week in 1932, according to the Car Service division of the American Railway Association.

Hows and Whys of Ja



Digging Ahead of a Culvert Pipe

The practice of jacking culvert pipe through fills has been adopted quite generally by the railroads in recent years as an economical and otherwise desirable method of installing pipe culverts where the local conditions are favorable to its application. With the thought, therefore, of increasing the fund of available knowledge concerning the problems involved in applying the jacking method, a subcommittee of the Committee on Roadway of the American Railway Engineering Association compiled a report on the subject which was presented at the March, 1934, convention of the A. R. E. A. The report, which was based on information obtained from 23 railroads and from manufacturers of culvert pipe, is abstracted herewith.

WHERE conditions are favorable, the installation of pipe culverts by the use of jacks is safe and rapid, and will usually be cheaper than other methods. The most widely used material for pipes installed by the jacking process has been corrugated iron, but cast iron pipe of the bell and spigot type, and special cast iron pipe have also been used, and a considerable amount of concrete pipe has been installed by this method. The proper kind of pipe to be used in any particular case can be determined by a consideration of the installation cost, the probable life, and the cost of maintenance.

If corrugated pipe is selected, it should be fabricated especially for jacking from eight-gage metal in lengths convenient to handle, about 12 to 18 ft., and should be punched and matchmarked for field-riveted joints. This pipe is made up in multiples of two feet, and an extra charge is made for odd lengths. If it appears probable that the life of the pipe will be lengthened thereby, it can be obtained with the invert paved with asphaltic cement.

If cast iron pipe is to be used, Class B will be suitable for most installations. The pipe may be of the bell-end type or have a special type of joint that gives the pipe an unbroken outside surface, thereby simplifying the jacking procedure. Concrete pipe, which is usually made in six-foot lengths, is available with special reinforcement and ship-lap joints that also present a smooth outside surface.

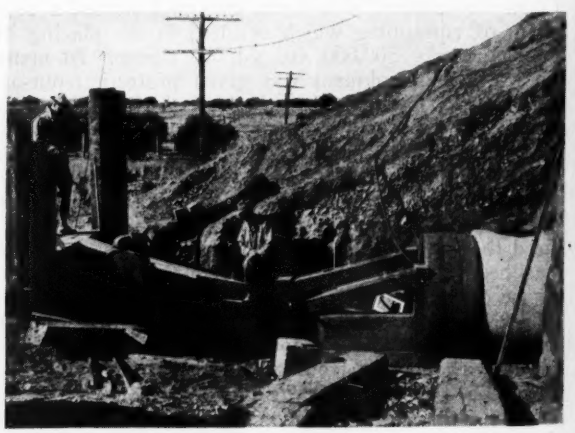
Pipe from 24 in. up to 68 in. in diameter has been placed by jacking without the use of special boring equipment, although 42-in. pipe is the least size that should ordinarily be used.

The Approach Trench

When starting a jacking operation, the bank is excavated so that a vertical face is presented to the entering pipe. The most economical length for this approach cut or trench will be determined by the relative costs of jacking and of excavation. Where the fill is high, 15 or 20 ft. will be about the proper length in most cases. Of course, the trench must not extend to a point where the stability of the track would be affected. For long lines of pipe it is also usually desirable to place 15 or 20 ft. of pipe in an open trench on the opposite side of the embankment from the starting point, although, if the jacking is easy, it may be desirable to place all the pipe by the jacking method. The approach trench is usually excavated by hand, but in some cases a power shovel can be used to advantage, and if concrete or cast iron pipe is being placed it is also desirable to have a crane to line up or rack the pipe. A crawler-type excavator can perform the latter operation and also dig the approach trench.

As a general rule, the pipe should be jacked uphill to facilitate drainage in the event that water is encountered in the fill, and to prevent interruption of the work by storm water. If concrete pipe is used, it is more easily maintained at the desired grade if jacked downhill, owing to the tendency of the front end of the pipe to work downward because of its weight; however this tendency can be controlled without great difficulty. In some cases shafts are sunk, from which the pipe is jacked both ways. This method simplifies the backstop problem, and decreases the length of pipe to be jacked.

Corrugated pipe may be unloaded without special equipment, but concrete and cast iron pipe are handled most efficiently with a crane. After being deposited alongside the track, the pipe can be rolled to the bottom



Jacking a 48-In. Concrete Pipe—Note the Jacking Head

of Jacking Culverts

of the fill by ropes. Care must be used in handling concrete pipe to prevent its being chipped; corrugated pipe also should be handled carefully as it has been punched and matched for field rivets, and extra expense will be incurred in correcting ends that have been bent or deformed in handling.

If the pipe to be installed is furnished in short lengths, it should be lined up or racked on timbers extending at right angles to the direction of jacking, and so placed that the pipe can be rolled on to the guide timbers in front of the jacks quickly and with little effort. This is not essential if corrugated pipe is used, as the individual sections will be longer.

The type of back-stop to be used will depend upon the nature of the ground in which it is located, the length of pipe to be jacked and the character of the material to be penetrated. For average conditions, a back-stop constructed as shown in Fig. 2 will be satisfactory. This illustration also shows the manner of placing the guide timbers and of constructing the jacking frame. The guide timbers, which may consist of 7-in. by 16-in. material, are set in the approach trench and carefully placed to line and grade. If the culvert is to be of concrete or cast iron, steel angles on the inner edges of the guide timbers will be desirable, this being particularly true if a cutting edge is used on the leading joint of the pipe.

The method of transmitting the pressure from the jacking frame to the pipe depends somewhat on the type of culvert pipe that is being installed. For corrugated and cast iron pipe, four 6-in. by 8-in. timbers framed to bear against the end of the pipe in such a way as to leave an opening sufficiently large to permit removal of the excavated material will transmit the pressure satisfactorily. For concrete pipe, a special jacking head (see Fig. 3) is recommended by the manufacturers of this pipe.

A steel cutting edge or shoe is sometimes used for concrete pipe, although if this shoe is annular in shape it is of doubtful value owing to the tendency of the pipe to dig into the bottom of the bore. In some cases, a special sled-like shoe has been bolted to the lower part of the leading joint of pipe in order to prevent it from working below grade. Where such a shoe is used, however the progress of the work must be watched carefully to prevent the pipe from getting above grade. A cutting edge is not necessary for corrugated iron pipe.

Jacks Required

The number and capacity of the jacks required depend upon the size and length of the pipe to be jacked and the nature of the embankment material. For the average job, two 15-ton track jacks and two 50 or 75-ton high-speed ball-bearing high-lift jacks should be provided. The operation can be started with small capacity jacks, which may also be used for taking up the compression in the blocking after the jacking gets too heavy for them. To avoid frequent resetting of the jacks, they should have not less than a 12-in. lift. On account of the greater weight involved in placing concrete and cast iron pipe, jacks will be required having a higher capacity than for corrugated pipe.

The number of men required for an average installation by the jacking method will be about as follows: One foreman; one man digging; one loading dirt into the wheel barrow or other conveyance used for disposal; one man taking the waste material away; and two men operating the jacks. Where progress is rapid, an additional man will be needed to help remove the spoil and in heavy ground or on long lines of pipe two men on each jack will expedite the work. Under favorable conditions, this force will place from 10 to 16 ft. of pipe in an eight-hour day.

Where the diameter of the pipe permits, spoil is generally handled from the pipe by wheel barrows. One barrow will be sufficient for short pipes, but two will be desirable for long pipes where the jacking proceeds at the rate of one foot or more per hour. Another method of removing spoil is to load it into a flat-bottom box equipped with wheels, which is pulled back and forth by means of a rope. This box is emptied into a wheel barrow at the end of the pipe, and the spoil wheeled away to the waste bank.

The preliminary work having been done, such as constructing the back-stop and the jacking frame, placing the guide timbers and excavating the approach trench,





Left—The Jacking Frame and Loaded Boat for a 30-In. Cast Iron Pipe

Right—Operating the Jacks in Connection With the Installation of an 84-In. Corrugated Iron Pipe

the work proceeds in the following manner: A joint of pipe is rolled on to the guide timbers and jacked against the bank. Digging is then begun from inside the pipe, the excavated bore being cut to grade at the bottom and about one inch larger than the pipe at the sides and the top. The man doing the digging casts the spoil back into the pipe, whence it is loaded into the wheel barrow or car by his assistant. A third man wheels the spoil out

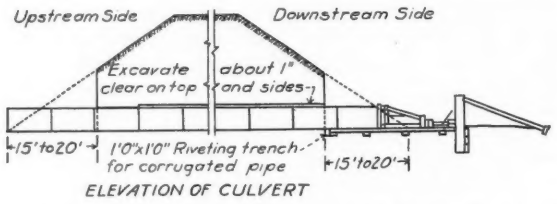


Fig. 1—Showing the Location of the Trench for Riveting Sections of Corrugated Pipe

through the pipe to the waste bank. It will sometimes be necessary to have an additional man to help pull the loaded barrow up the incline out of the pipe. Where two barrows are being used, the man handling the ingoing barrow assists in getting the outgoing barrow up the incline. In this manner the jacking goes forward continuously until the limit of travel of the jacks is reached. Additional blocking is then placed and the process continued until there is room for another joint of pipe.

The grade and line of the pipe must be watched carefully and corrected when necessary. This can be done by wooden wedges. If available, an engineer's transit

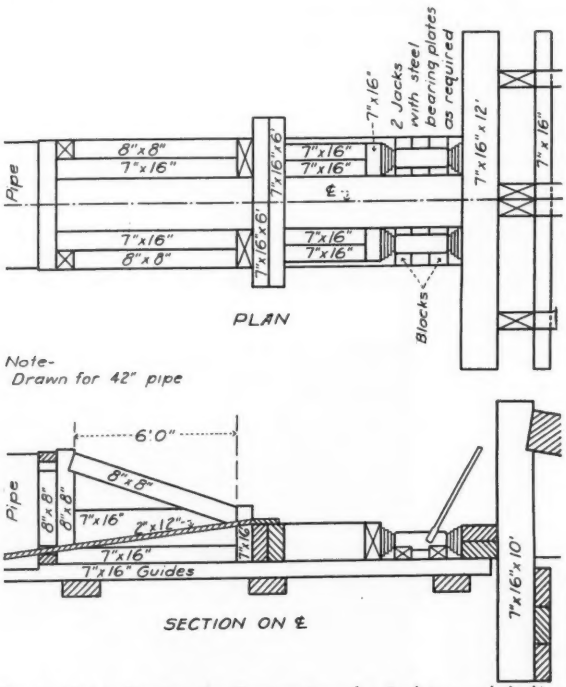


Fig. 2—Sketch Showing the Construction of a Backstop and Jacking Frame Suitable for Average Conditions

will be the most satisfactory means to keep the pipe in line, but sufficiently accurate work can be done with a straight edge and spirit level if care is taken in using them.

Corrugated pipe is joined by riveting the sections together as each additional section is rolled into place. To accomplish this, a trench about one foot wide and one foot deep at right angles to the line of jacking is necessary, the usual location of this trench being shown in Fig. 1. Corrugated bands are sometimes used at the joints and ordinarily these should preferably be used on the inside. Rivets can be driven cold, but better results will be secured if they are heated.

Cushioning Concrete Pipe

If the pipe is of concrete with ship-lap joints, some form of cushioning between the joints will reduce the likelihood of breakage due to concentrated pressure. A length of ½-in. Manila rope stuck to the end of the pipe with some form of asphaltic cement will be satisfactory for this purpose. After the pipe is in the final position, the joints can be grouted if this appears desirable. Cast iron pipe of the bell and spigot type requires no special provision for joints. However, after pipe of this type is in place, the joints can be grouted or filled with asphaltic cement.

The tools commonly employed for digging are short-handled picks and shovels, while in some soils an adze will be found useful. Compressed air diggers can frequently be used to good advantage, and where rock or

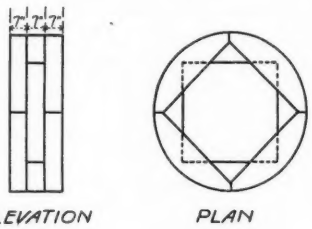


Fig. 3—Details of the Jacking Head Used When Installing Concrete Pipe

shale is encountered air drills will be needed. In long pipes the exhaust from air tools is of value in ventilating the pipe.

The distance to which the excavation can be carried ahead of the pipe will depend upon the character of the ground and the depth of the work below the track. In very favorable soil the distance may be as much as four feet, although ordinarily it will be one or two feet. However, under any circumstances, it is dangerous to carry excavation any farther ahead of the pipe than is absolutely necessary.

In short pipes of large diameter artificial light will not be necessary, but in most installations the work will be expedited by the provision of ample illumination. Oil lanterns are largely used, but, if available, electric lamps will be found more satisfactory.

Procedure in Unstable Soils

The jacking method is not well adapted to placing pipe in unstable soils and before undertaking an operation of this kind a very thorough investigation of conditions should be made. Borings into the fill may be desirable where there is doubt as to the nature of the material. If jacking is decided upon, it will probably be desirable to prosecute the work continuously to minimize the tendency of the material to "freeze" around the pipe. If the pipe sticks, it may have to be jacked from both ends and possibly from intermediate shafts. The resistance to jacking caused by material settling in the corrugations of corrugated pipe can be reduced by riveting strips of sheet iron lengthwise on the exterior. The approach trench should be properly sheeted and braced on the sides and working face.

In unstable soils the excavation should not be carried

(Continued on page 268)

Rail Orders Rise in April

Commitments of 11 roads aggregate 174,862 tons, bringing the total placed since October 1, 1933, to 633,579 tons

SINCE the publication of the April issue of Railway Engineering and Maintenance, orders for rail totaling 174,862 tons were placed by 11 railroads, thereby increasing the total tonnage placed since October 1, 1933, to 633,579 tons. In addition to this total, which represents the aggregate orders of 38 roads, contemplated purchases by four other roads amounting to 14,188 tons, increase the total definitely in sight to 647,767 tons, or 14,820 tons more than the corresponding figure recorded in last month's issue. Furthermore, it is to be expected that this tonnage will be amplified by orders from still other roads that have not yet announced their requirements. That the tonnage still unaccounted for should assume considerable proportions, is evident from the fact that the 42 roads represented in the accompanying list do not include an appreciable number that have been large buyers of rail in the past.

Rail Orders Placed or Pending, Including Orders Placed Since October 1, 1933

Railroad	Tons of Rail Pending But Not Yet Ordered	Tons of Rail Ordered
A. T. & S. F.		34,700
A. C. L.		5,000
B. & O.*		35,000
Ban. & Aroos.		3,500
B. & M.*		30,000
Cent. of Ga.*	3,000	
C. & E. I.*		4,000
C. & N. W.*		25,000
C. B. & Q.		25,000
C. G. W.		3,400
C. M. S. P. & P.*		20,000
Clinchfield		2,500
D. & H.		5,000
D. L. & W.		12,000
Erie*		29,987
G. T. W.*	4,250	
G. N.*		20,000
I. C.*		20,000
K. O. & G.*	5,186	
L. & H. R.		1,000
L. & N. E.		3,202
L. & N.		17,500
Me. Cent.*		4,200
M-K-T		4,700
M. P.		25,000
N. C. & St. L.		4,000
N. Y. N. H. & H.*		25,000
N. Y. C.*		38,900
N. Y. O. & W.*		4,725
N. & W.		20,000
N. P.		6,500
Penna.*		100,000
P. M.		1,050
P. & W. Va.*		1,000
R. F. & P.		500
St. L.-S. F.		18,000
S. A. L.		19,215
S. P.*		40,000
Southern		10,000
Wabash*		10 000
West. Md.		4,000
Wis. Cent. (Soo Line)	1,752	
Total	14,188	633,579

*Federal loans pending or granted.

Of the 11 roads that ordered rail during the last month, seven, including the Baltimore & Ohio, the Erie, the Great Northern, the Maine Central, the New York Central, the New York, New Haven & Hartford, and the New York, Ontario & Western have been granted loans from P. W. A. funds, while the other four are financing their purchases from corporate funds. These include the Clinchfield, which has supplemented an order of 500 tons last fall with 2,000 tons additional; the Norfolk & Western, which has ordered 10,000 tons, thus duplicating an order placed last October; the Nashville, Chattanooga & St. Louis, which has ordered 4,000 tons; and the Pere Marquette which has placed an order for 1,050 tons.

Marked progress has been made by the Public Works Administration during the last month, in closing negotiations with the roads that were among the last to apply for federal aid in the purchase of materials or the employment of labor in maintenance of way and structures. Thus, since the publication of last month's issue, the Public Works Administration has executed contracts for loans to five railroads as listed below:

Central of Georgia, $120,000 for 3,000 tons of 90-lb. rail and the necessary fastenings.

Great Northern, $4,935,000, of which $3,108,000 is for roadway improvements, including $2,123,000 for 20,000 tons of rail and other track materials, as listed in last month's issue, and $985,000 for labor.

Maine Central, for $313,000, of which $168,798 is for the purchase of 4,200 tons of rail, $105,147 is for fastenings, $18,903 for frogs and switches, and $3,913 for guard rails.

New York, New Haven & Hartford, $3,600,000, of which $983,000 is for the purchase of 25,000 tons of rail, $158,276 is for 40,026 pairs of rail joints and $158,724 is for other track materials. The remainder of the loan is for the purchase of passenger equipment.

New York, Ontario & Western, $235,000 for 4,725 tons of rail and 1,751 tons of track accessories.

In addition, the Interstate Commerce Commission has approved the application of the New York Central for a loan of $2,500,000, of which $1,345,875 is for 37,000 tons of rail, $745,125 is for other track materials and $400,000 is for labor. This road has, however, purchased 38,900 tons of rail during the month.

Deficiencies in Maintenance Reviewed

The fact that there has been a well defined deficiency in rail renewals during the last four years, is aptly illustrated in the commission's analysis of the situation presented on the New York Central, which is abstracted in brief below:

The number of tons of rail laid in replacement for the years 1922-29, inclusive, averaged 191,061, while for the years 1930-33, inclusive, the average was 75,119 tons, representing a yearly decrease for the latter period of 115,942 tons. If the average number of tons of rail laid in renewals for the years 1922-29, inclusive, be accepted as indicating the applicant's normal standard of maintenance, then on the basis of the use of the tracks as reflected in a decrease of 31.5 per cent in the average number of ton-miles of freight for the years 1930-33, inclusive, the laying of 130,800 tons of rail yearly would have been required to maintain this standard during the latter period, while the actual renewals averaged 75,119 tons, indicating a yearly deficiency of 55,681 tons. If the number of tons of rail required for the years 1930-33 be adjusted on the

basis of the decreased average number of ton-miles of freight during the years 1929-32, as compared with the years 1921-28, the yearly deficiency would be approximately 80,000 tons. In either case, the purchase and installation of 37,000 tons of rail represent but a partial restoration of the indicated deficiency in rail replacements during the past four years.

A similar analysis covering the Grand Trunk Western, with 1,024 miles of line, indicated a need for the replacement of 11,228 tons per year for the last four years, compared with actual replacements averaging 6,731 tons. On the Central of Georgia, the renewals averaged 1,325 tons per year, as compared with calculated requirements averaging 8,130 tons per year. In reviewing the requirements of the Great Northern, the commission arrived at an estimate of 55,000 tons as representing the deficiency in rail renewals for the four years 1930-33.

Deficiency on the Great Northern

The commission's report on the Great Northern also discusses deficiency in bank widening, ballasting and tie renewals. Its statement in support of the allotments of $1,652,286 to that railway for these purposes being in part as follows:

The applicant has furnished information as to its annual expenditures for ballasting from 1922 to 1933, inclusive, and as to gross ton-miles of traffic from 1921 to 1933. If the expenditures for the years 1922 to 1929 be accepted as indicating the requirements to maintain the applicant's standard roadway under the traffic of 1921 to 1928, the ratio of the average ton-miles a year for 1929 to 1932 to that for 1921-28, applied to the average expenditure for the 1922-29 period, would appear to provide a fair indication of the proper amount of expenditures to maintain such standard during the later period. On that basis the deficiency in expenditures for 1930-33 is slightly in excess of $1,000,000. The expenditure of $501,500 for ballast is, therefore, reasonable.

The applicant's annual reports to us indicate that from 1922 to 1929 an average of 2,228,964 ties annually were laid in replacement, while from 1930 to 1932 this average was reduced to 1,724,917. The number of ties laid in 1933 is not available, but assuming a figure equal to the average for 1930-32, the deficiency in renewals for the four years, compared with related service as indicated by the ton-miles for the two periods, would be approximately 1,000,000 ties.

Jacking Culverts

(Continued from page 266)

more than a few inches ahead of the pipe. In wet sandy soils, dewatering by means of well points may prove beneficial. For obvious reasons bell and spigot type pipe will not be as suitable for installation in unstable soils as that presenting a smooth exterior.

Protection of Pipe Against Percolation and Scour

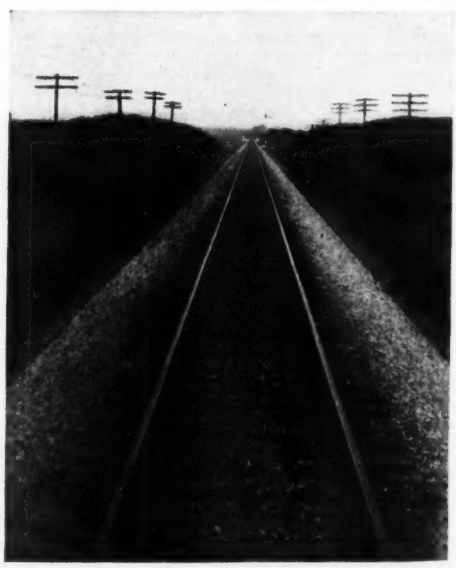
If it is anticipated that the pipe will discharge under head for any considerable period, and particularly if it lies in easily eroded material, the same precautions against percolation along the outside should be taken as in the case of conduits through earth dams. Concrete collars or cut-off walls will be found effective for this purpose, although it will likely be impracticable to place more than two of these on one pipe owing to the additional amount of excavation required and other difficulties involved. The collars, therefore, should be made larger than if they were built at closer intervals. In addition, concrete pavement on the upstream end of the installation, extending beyond the limits of the open excavation and tied in to the pipe headwall, will add to the security of the installation. If the fill does not settle around the pipe, the resulting space may be filled with a mixture of mud and cement, consisting of about one sack of cement per cubic yard of the mixture. In extreme cases outlet works for dissipating the energy of the issuing water will be justified.

In all installations, the back-fill at each end should be well rammed around the pipe, and sometimes the excavation for the last joint of pipe can be made slightly smaller than the pipe, thus increasing the resistance to percolation. If it is necessary to protect the ends against scour, this can be done by concrete pavement or riprap, except that, as mentioned in the foregoing, extreme cases will require more extensive protection.

Conclusions

The conclusions of the committee are that where conditions are suitable, the placing of pipe culverts by the jacking process is feasible and will save from 30 per cent to 50 per cent of the cost of placing the pipe by the open trench method and will be cheaper than tunneling. Pipes have been installed by this process in practically all types of material from rock to quicksand. The advantages of the method are: Usually lower cost, no interruption of traffic, and minimum disturbance of the roadbed, with little or no subsequent settlement. This method is particularly applicable where more than one track is involved, where the fill is high, where the material to be penetrated is clay or similar soil that will arch or stand up well, and where the traffic is heavy. Costs will be higher, although not necessarily prohibitive, in unstable soils and embankments containing boulders, stumps, waste from rock cuts, or similar obstructions.

Before it is decided that jacking is the proper method to use, all conditions involved in the operation should be investigated, and if studies show that the method is of doubtful economy, cost estimates for open cut placement or tunneling should be compared with the probable cost of jacking. Such estimates should include expense due to interference with traffic, and excess maintenance until the embankment becomes stabilized. Generally, jacking operations will have little or no effect upon the stability of the track.



A Typical Section of Track on the Santa Fe in Oklahoma

Termites— Methods for Combating Them*

By DR. HERMANN VON SCHRENK
Consulting Timber Engineer, St. Louis, Mo.

WHILE the destruction of wood in various forms by termites, or "white ants" as they are commonly called, has been recognized for many years all over the world, it is only in comparatively recent times that they have attracted widespread attention in the United States. In some quarters the impression has grown that whenever wood is used, termites are bound to destroy it. There is little reason for such fear. Most buildings are free from termites and probably will remain so, because they were properly constructed in the first place. Fortunately, termites generally reveal their presence by failure in woodwork, in door or window frames, flooring, mantels, etc. Termites usually swarm inside buildings in the spring, which is an indication that the insects are active. These indications usually occur in the early stages of termite attack. If one does *not* find these signals, it is usually safe to assume that there is no necessity for anxiety.



Note How the Spring Wood in This Piece of Yellow Pine Has Been Eaten Out by Termites

Most buildings are free from termites and will probably remain so, but the fact remains that damage to wooden structures from this source has been reported with increasing frequency in recent years. In this article, Dr. von Schrenk tells how termites obtain access to buildings, how their presence may be detected, and what precautions may be taken to protect property from their destructive invasion.

Termite nests or colonies are rarely found, because they are always hidden underground. The appearance of termites in a building does not mean that the so-called "nest" is in the house, or anywhere near the house. It may be a long way off. Termites eat any kind of organic material. Their chief food consists of wood, although they will attack books, wall paper, vegetables, shoes, etc. They attack all woods growing in the United States, although some of them have proven more resistant on occasion than others.

Points of Entrance

Termites enter a building only from the soil. In other words, there must be some approach from below the ground into the building. They cannot start their operations by coming into a building through doors or windows.

One of the most likely points of entrance is through foundation walls. These walls are frequently built of individual stones laid in mortar which is generally put on fairly heavily on the outside but only in small amounts in the interior of the wall. After a period of time, cracks may form in the mortar, thereby giving the insects a ready point of entrance. This is particularly true if lime forms an important constituent of the mortar, for the termites can dissolve lime mortar.

The second point of attack is in and around window casings placed in depressed points like basement windows, coal windows, basement stairways, etc. Posts in a basement used for walls of storage bins and door frames similarly situated are frequent points of attack. Water and other types of pipe, coming through concrete floors or through walls, frequently offer a point of entrance. In houses or parts of houses under which there are no basements, the method of entrance may consist in building shelter tubes vertically from the ground. We have noted many cases during the last few years where termites got into buildings through concrete walls and in each of these cases the walls were made of improperly tamped concrete, which resulted in air pockets.

Another point of entrance which is more common than is generally supposed is cracks between adjacent slabs of concrete or between slabs of concrete abutting against vertical walls. Concrete contracts as it ages, not very much to be sure, but sufficient to separate adjoining slabs and leave them sufficiently separated to give the termites an opportunity to enter. At a new passenger station on the Kansas City Southern at Beaumont, Tex., constructed entirely of concrete and hollow tile where the only wood in the building was the benches in the waiting rooms, one of these collapsed last year. We found that the termites had gotten into

*Abstracted from an address before the annual convention of the American Wood-Preservers Association at Houston, Tex.

this building through shrinkage cracks between adjacent slabs. In another case in the Central West this year, the termites got into a large powerhouse in which there was not a speck of wood, but were observed building tunnels on the concrete walls; here again they entered through the shrinkage cracks. Incidentally, the one thing they would eat in this powerhouse was the insulation of the electric cables.

How can one tell when termites are in a building? The first and most positive indication of their presence is the observation of swarms within a building. This always means that the workers are in the woodwork of the building. If there is no such observation, the next thing to do is to examine the woodwork on the lowest floor, preferably from the basement. If the



This View Shows a New Drawing Board That Was Attacked by Termites While in Storage

ceiling of the cellar consists of lath and plaster, a sufficiently large strip of the lath should be taken off and an examination made of the joists, stud and top of the wall. The important thing to look for is the shelter tubes or carbon-like building material which will usually be evidenced if the insects are at work. Frequently these shelter tubes will be visible on the walls of the cellar. A similar examination should be made of all low windows, posts, or any woodwork in contact with the ground immediately adjacent to the walls, both inside and outside. When there is no basement under the building, a diagnosis is usually very difficult and no exact directions can be given because every case differs. Numerous cases where termites have been found in buildings constructed almost on the ground emphasize the desirability of developing a different kind of design.

Preventive Construction

Hitherto, architects and designing engineers have paid little attention to termite infestation. Yet, it is possible to so design and construct a building that there will never be a chance for termites to enter it. Termite-prevention methods should be used for every building that is constructed, no matter where it may be. Fortunately, the expense involved is usually very small. The principal points to watch are as follows:

1. Use only cement mortar in the construction of foundation walls.
2. Carry the foundation walls a sufficient distance above the ground so that woodwork of any sort will be removed from the surface of the ground.
3. Provide all foundation walls with approved copper or other long-lived metal shields. The strips of the shields should be soldered where the ends overlap. Furthermore, the overhang of these shields should be at least 3 in. beyond the wall and the 45-deg. bend should be at least 2 in. wide. The shield should extend on both sides of the foundation wall—that is, inside and outside the building.
4. Irrespective of whether shields are used or not, the top surface of the foundation wall should always consist of a coating of rich cement mortar, carefully trowelled.
5. All openings through the foundation walls for window casings, cellar doors or other purposes should be covered on all surfaces with rich cement mortar so that there may be no chance for termites to get from the foundation wall into the wood casing.
6. Concrete slabs should provide triangular depressions where they join vertical walls or where adjacent slabs abut against each other. After the concrete has hardened, these joints should be filled with a fairly plastic coal tar pitch. I emphasize the word coal tar, for asphaltic compounds are of no use whatever.
7. When there is to be an unexcavated section under the house, wherever possible lay a thin concrete floor on the soil to prevent entrance by means of vertical tubes to the woodwork overhead. Use pitch seals between slabs and at the walls.
8. In basements, lay the concrete first and put any boards or posts on top of the concrete.
9. Provide all pipes of every kind with copper shields near their point of entrance into the building.
10. Where wood has to come in contact with the ground or where it is located very close to the ground, as in porches, use only treated lumber, preferably treated according to the specification of the American Wood Preservers Association with coal tar creosote. Termites will not attack creosoted wood where the treatment has been done efficiently. When lumber is used on the inside of the building, use zinc treatment.
11. When possible, cover the outside of the foundation wall with a good quality of coal tar pitch.

The Old Building

What shall be done with the building that has already been constructed, and where termite attack is evident? There are two possible methods of attack, one involving structural changes made for the purpose of discovering the point of entrance and the other attempting in some way to poison both the wood, the foundation walls and the soil by the use of toxic substances. I have for more than 30 years followed the practice of determining the point of entrance and making such structural changes in the building as would give reasonable assurance that the termites would hereafter fail to find a point of entrance. These structural changes involve the digging of a trench around the foundation walls, cleaning and coating the walls with a rich cement plaster, and then following with one or more applications of coal tar pitch. The same process applies to changes made in window openings, door frames, etc. Where termites have entered a building through the foundation walls, it is frequently necessary to reconstruct the top of the wall, placing termite shields and replacing structural joists, studs, etc., with creosoted material; reconstructing concrete slabs with pitch seals, and replacing improperly constructed floors with termite-resistant materials; also replacing the woodwork on the outside of the building with treated wood.

Rail and Flange Lubrication*

A review of the problem, the devices available to meet it, and the economies possible

By D. M. CLARKE
Service Engineer,
Maintenance Equipment Co.



Rail Lubricators Have, in Effect, Reduced the Degree of Many Curves

RAIL and flange lubrication has interested the steam railways only during the last 10 or 15 years, and it has only been during the last 7 years or more, with the development of satisfactory curve lubricators for installation in the track, that the practice of lubricating wheel flanges and curved rail has become thoroughly practical and economical. Today there are hundreds of track lubricators in service on the railways, and it is only reasonable to assume that as the merits and economies of these devices are more generally and fully appreciated, there will be many additional installations.

Curve Lubricators, Not Track Oilers

The term "Track Oilers," as used quite generally, is misleading and a misnomer. Most persons think of track oilers as the spraying equipment used to coat the rails and their fastenings with an asphaltic oil to protect them against the corrosive action of brine from refrigerator cars. The correct term, when referring to devices attached to the rail and designed to put a coating of lubricating oil or grease on the wheel flanges of cars and locomotives, and thus reduce flange and rail wear on sharp curves, is "track lubricators," and the results secured should be termed "curve lubrication" and not curve oiling.

The problem of preventing the excessive wear of rails on sharp curves, as well as that of reducing the annoying "squeal" of wheels on these curves, was encountered years ago by the street, subway, and elevated railways. Their problem was met by the hand application to the rail of either a heavy asphaltic oil or a grease containing a good percentage of graphite. In the case of the steam railroads, the advent of the larger locomotives and heavier rails accentuated the wear on both the rail and wheel flanges, and hand methods of lubrication proved inadequate and too expensive for widespread use. The large potential savings on the railways through the reduction of wheel flange and rail wear prompted work on a feasible solution of the problem in both the mechanical and track departments. Lubricating devices were developed and have been promoted in both departments, but it has been proved finally that an automatic device attached to the rail is the more reliable and economical method of lubrication of rail.

The various methods of flange lubrication tried by the mechanical department have included devices for applying oil, grease and stick graphite directly to locomotive tire flanges. The oil and grease methods were of two general types. One type was hand-operated by the fireman when reaching curves. The other type was supposed to be automatic and usually employed centrifugal force to open a valve when going around curves. The results obtained by this latter method varied with different speeds of the train. The graphite stick method operated by having the stick in contact with the wheels at all times, spring action or gravity being employed to keep the feed continuous. Locomotive flange lubricators apply lubricant on locomotive wheels only. For this reason, with this type of lubricator, it is seldom possible to transmit sufficient lubricant to the curved rails to protect them against wheel flange wear, except in the case of the first few cars directly back of the locomotive.

Curve Lubricators Attached to the Rails

The first lubricators designed for the track department used oil as the lubricating agent. Early it was found that heavy oil is more efficient than light oil, since it has more body, and that asphaltic base oils adhere to the wheels longer. This is important in high-speed territory since centrifugal force tends to throw the lighter oils off from the wheels. This same action tends to make the oil run to the bottom of the wheel flanges. Heavy oils, on the other hand, were found to change their consistency considerably at low temperatures. Thinner oils were tried, but these lighter body oils afforded less protection. Certain heavy oils with a small percentage of graphite gave about the same results as asphaltic oils.

In addition to the troubles encountered by the varying consistency of oils due to changing temperature, trouble was also encountered in connection with the application of locomotive sand on grades and in yard districts. This was true particularly with lubricators that had a semi-open container on the gage side of the rail. Several lubricators were devised to squirt oil on the wheel flanges or rail head, and thus overcome most of the sanding problem, but these machines still had the problem of the changing viscosity of oil.

The oil lubricators developed are operated by several methods, among which are the following:

(1) Wave motion of the rail, operating ratchets or plungers.
(2) Plungers operated by the flanges of the wheels.
(3) Ramp levers operated by the flanges of the wheels, which, in turn, make use of ratchet cranks or plungers.
(4) Motors, controlled by track circuits.

The first grease lubricators developed made use of heavy greases, similar to that used for hand application by the elevated and subway railways. These greases

*Presented before the Metropolitan Track Supervisors' Club at New York.

were not entirely adapted to use in automatic grease lubricators, especially because they contained small solid particles which frequently plugged the discharge orifices of the lubricators, and therefore required considerable cleaning and maintenance. At present there are several greases on the market which have been made especially for use in automatic lubricators, and which permit continuous operation of these machines with very little maintenance.

From the first, it was found that grease lubricators gave evidence of greater carrying ability than the older types of lubricators. Weather and sanding conditions have little effect on their operation. It was also noted that the degree of protection was increased by the use of greases containing from 15 to 20 per cent of graphite.

Grease will adhere to the wheel flanges where it is applied, and, as a result, it is possible to apply it to the curved throat of the wheel flanges without danger of getting it on top of the rail. Centrifugal force at high speeds has little effect in throwing grease off the wheels after application, which results in a cleaner appearance of the track and a saving in grease. In other words, grease stays on the wheels until it is removed by contact of the wheels with the gage side of the rail head. This means that greater "carry" of the grease is obtained and makes it possible to lubricate several curves with one lubricator, even though certain of them are a mile or more from the lubricator.

It has been found that by making use of the overhanging edge of the wheel tread to operate the pumping mechanism of a lubricator, a more uniform discharge of lubricant can be obtained. This is because there is little variation in the treads of the wheels.

Proper Location of Lubricators

The location of lubricators is often a very important factor in the character of the lubricating results obtained, and varies with different types of lubricators. The location is also affected considerably by such local conditions as traffic, grades, the number and spacing of the curves to be protected and whether the installation is to be in single or in multiple-track territory. In general, the grease lubricator is located in tangent track, ahead of the elevated easement. This allows the wheels to contact the grease, without squeezing it up on to the wheel tread or forcing it too low on the flanges. Properly applied in this manner, the grease adheres to the wheel flanges where it is available for the lubrication of the curved rails when the flanges come in contact with them. The specific location of the lubricator should be near the point of curve where a neutral condition of wheel thrust is encountered, as indicated by equal flange wear on both rails.

In double-track territory, or where traffic is in one direction most of the time, the lubricator should be placed in the tangent just ahead of the curved territory to be lubricated. If the curved territory has more curved rail in it than can be protected by one lubricator, additional lubricators should be installed where the lubrication from the preceding lubricator appears to be insufficient to carry around the next curve.

In a great number of locations, careful consideration of the existing physical conditions is advisable. In single-track territory, or where traffic operates in both directions over the same track, the lubricators should be placed in tangents somewhere in the curved territory. Usually, the first lubricator should be placed so that the amount of curved rail between the lubricator and the end of the curved territory is equal to about half the normal curve protecting ability of the lubricator. This is because this first lubricator must lubricate the curved section ahead of it sufficiently for trains in both directions, while utilizing traffic in one direction only for applying the lubricant to the rail. When only a single curve subject to two-way traffic is to be protected, as is often the case where there is a single sharp curve in an otherwise light curve territory, it is well to consider most carefully the type of lubricator to be used and the best location for its installation.

Rail and flange lubricators are used to large advantage within terminals and yards. In this service a lubricator can be placed to take care of an entire ladder track, protecting not only the switch points, but also the curved leads and any curves in the same direction on the tracks beyond. The location for this type of service is usually on pull-in or hump tracks. The grease type of lubricator is especially adaptable to this service since it is troubled less by sand and variable speed. The benefits of lubrication applied to wheels in equipment entering a terminal are frequently extended to outbound routes by means of the grease that remains on the wheels.

Advantages of Lubrication

In thinking of rail and flange lubrication, most track men are inclined to consider it only from the standpoint of the savings effected as a result of the increased life of rails. This is only one of the many savings effected, and amounts to only a little over half of the actual savings possible. Wherever lubricators have been used to any extent, good reports have been given as regards savings from the following additional factors:

(1) Reduction in expense for the lining and surfacing of curves.
(2) Reduction in the amount of track re-gaging.
(3) Reduction in the amount of flange wear on car wheels and locomotive tires.
(4) Increased tonnage rating due to the reduction of train friction resistance.
(5) Increased speed of operation on curves with safety as a result of the elimination of the hazard of derailments due to sharp wheel flanges.

Naturally, it is advisable to calculate the savings that will accrue from the use of rail lubricators before deciding on their use. From the standpoint of the track department, this calculation is relatively simple. In general, it is economical to lubricate curves where the rail, because of flange wear, has to be renewed within six years. It should be remembered that it is the amount of curved rail protected and not the distance the lubricant carries, which is important.

Rail lubricators, like all machines, demand care. The results obtained from them are in direct proportion to the interest shown by those who have charge of them. Proper care in keeping foreign material out of the grease is important. It is also important to make occasional inspection of the lubricators to see that they are operating properly.

One of the most important factors in the satisfactory and economical operation of an automatic rail and flange lubricator is the use of a proper lubricant. The lubricant used, more than any other factor, is the cause of varying results obtained by different roads. In this connection, it should be borne in mind that the lubricator is really only a device for pumping whatever lubricant is used, to a position where the wheels can come in contact with it as they pass the machine. The amount of lubrication obtained and the cost of maintaining lubricators vary considerably with different greases. It is important to keep in mind, therefore, that it is not the first cost of a lubricator that is the most important, but rather, the ultimate cost of adequate lubrication per foot of curved rail.



In reviewing the accidents occurring in motor car operation, "it is surprising * * * to note the number of division engineers, roadmasters and supervisors who are involved," says Mr. Gutelius. "As long as this condition exists I suggest that these officers first take steps to correct their own faults before they can expect safe motor car operation by subordinates."

Reducing the Hazard of Motor Car Operation*

By F. P. GUTELIUS, Jr.

Division Engineer, Delaware & Hudson, Oneonta, N. Y.

TO insure safe motor car operation, it is my firm belief that we must first convince ourselves as supervisory officers that it is unnecessary to take risks in operating these cars, and having done this we are then in the proper frame of mind to instruct in a convincing manner those whose daily operations require motor car movements on main tracks.

I do not believe that there are many officers concerned with motor car operation, who have not been guilty at one time or another of careless operation. It is surprising, as we review the accidents occurring in motor car operation, to note the number of division engineers, roadmasters and supervisors who are involved. As long as this condition exists, I suggest that these officers first take steps to correct their own faults before they can expect safe motor car operation by their subordinates. I also believe that every one of us has had occasion to hold investigations surrounding motor car accidents and that in practically every case the investigation has developed that the individual responsible did not understand his instructions or failed properly to execute them. This is a supervisor's responsibility and the number of times that justice has erred in meting out discipline is to be regretted.

Another angle to this situation involves certain of our track foremen. On all roads there are foremen well along in years who have been brought up in the hand-car school of track maintenance, but who are now charged with the responsibility of operating motor cars. These men may be very good foremen, capable of handling men and maintaining track in good condition, but who, owing to their years of service or lack of education, are incapable of comprehending the exactitude required in safe motor car operation. I believe that we are unfair to expect this of them.

Requires Education

With this condition existing, how are we to obtain a desirable degree of safety in motor car operation? I am thoroughly convinced that after the supervisory force has recognized the importance of safe motor car operation, it is purely a matter of educating the subordinates. A means of providing this education on those roads that are operating motor cars without an established set of rules, or on those roads where a set of rules is purely incidental to the motor car operation, can be found in the manual of the American Railway Engineering Association for 1929. After a number of years of study, this association adopted a set of rules governing motor car operation in all of its phases, including the train rules of the A. R. A., which are commonly encountered in this operation.

In order intelligently to understand and apply these rules one must, of necessity, have at least a grade school education and a mechanical turn of mind. As intimated before, there are on the various roads foremen charged with the operation of motor cars who are not thus equipped, and the thought has therefore occurred to me that we should provide these men with such equipment through the medium of an employee known as a motor car operator. The Interstate Commerce Commission has provided us with an employee carrying this classification,

*Abstract of a paper presented before a joint meeting of the Safety Section, American Railway Association and of the Steam Railroad Section of the National Safety Council at the Twenty-Second Annual Safety Congress and Exposition at Chicago.

known as No. 24, and I believe the position of motor car operator should be established on those gangs where the foreman and assistant foreman are not capable of handling this work.

This man should be held entirely responsible for the movements of his car over his territory. He should be instructed in the various rules governing the operation of motor cars and should have a working knowledge of the details of his car. The position could carry some slightly increased compensation over the hourly rate established for the trackman or laborer in the gang. Incidentally, such an employee would relieve the foreman or assistant foreman of the time he has been in the habit of devoting to the maintenance of the car.

The cost of maintaining motor cars, if the record of the Delaware & Hudson can be assumed as approximating the average on American railroads, runs anywhere from two to two and a half times the actual cost of operating them. This ratio is entirely out of line from an economical point of view, and I believe that in their daily maintenance and operation of the car the employees sometimes do more damage than good to the car, which, of course, shortens its life and increases its maintenance cost. I believe that with qualified motor car operators in each gang, these maintenance costs will be materially reduced, and probably more than offset the increased compensation paid to the operators.

What Is a "Qualified Operator"?

I have used from time to time the expression, "qualified operator," and in defining this term let me ask the question: "What is a qualified operator?" The general answer is that it designates a man qualified in rules, which, of course, means nothing. A parrot can qualify in the rules. I believe that each supervisor, in selecting the man who is trying to qualify as a motor car operator, should exercise a great deal of care. Possibly the most intelligent man in the gang is the man to select, but this is not necessarily true. After the man has been chosen, he should be instructed and examined in the rules current upon that particular railroad.

In the reorganization of the maintenance of way forces that is constantly going forward on all railroads because of the business depression and the more permanent nature of our track and structures, we have increased the hazards surrounding motor car operation, principally by increasing the length of the sections. We should combat this hazard by exerting every effort to place the operation of motor cars in the hands of competent employees. Our general officers recognized this fact several years ago. We had been in the habit of operating motor cars under a course of instruction that had been born of experience, and it had been our practice to buy motor cars and send them out to the foremen. In fact, many foremen bought the motors themselves, which the railroad installed in a hand car chassis. I should not be surprised if this condition still exists on a number of railroads. Through the bitter school of experience we learned that this form of motor car operation was defective and unfair to employees and employer alike. In fact, every motor car accident we had taught us a lesson which was incorporated in an instruction, with the result that we accumulated a group of loose-leaf instructions that were constantly changing and often conflicting.

Recognizing the value of the A. R. E. A. manual of rules and instructions pertaining to maintenance of way employees, we used this information as a basis for a group of instructions adapted to our local conditions. It was then a problem of educating the individual operator. The old system of placing this task in the hands of the roadmasters was discarded because many were of the old school and could not readily adapt themselves to the new conditions. Therefore, through the co-operation of the operating department, the services of the division rules examiner were made available to us. This man, knowing the transportation rules, has made an ideal instructor for this purpose.

The candidates selected for the course were those capable of passing the eye-test car examination satisfactorily. Classes were held once a week in the evening, and were fully attended. After an instruction course of from six to seven weeks, the embryo motor car operator was given a written examination and his paper reviewed and graded by the rules examiner. If his grade was satisfactory, this was so indicated on the candidate's service record. This course was also compulsory for roadmasters, track supervisors, bridge and building masters and supervisors, with the result that at the end of the examination period, the men were all qualified under the general rules and of the same mind as to their interpretation, which formed a sound foundation for the safe operation of motor cars. In addition, periodic instruction dealing with the lubrication, operation and relative functions of all exposed parts on the motor car was given the individual operators by the motor car maintainer. These employees have since been required to pass an oral examination every two years, visit the eye test car regularly, and are subject to the rules governing standard watches.

It would appear that a concentrated education of this nature would result in an immediate reduction in the number of motor car accidents. However, such was not the case. We still continued to have them at regular intervals, but now the investigations surrounding them revealed in practically every case that the accident was caused by a man failure, usually a failure of the operator to live up to his instructions.

Typical Accidents

In order to illustrate how unnecessary many of the motor car accidents are, I will cite a few of our experiences. We had a roadmaster who was very proud of the speed with which he operated his motor car and who also was a lover of animals. On one of our branch lines he was in the habit of racing a dog with his motor car, but on this particular day the dog won and fouled the track ahead of his motor car, which resulted in disaster to the dog and the wreck of the car. The roadmaster has never recovered from the bruise he received behind his ear when his head came in contact with the rail. Obviously, this was a foolish accident.

Only recently a general foreman, who had been subject to dizzy attacks in the morning prior to going to work, undertook to operate his light inspection car alone. One of his attacks occurred as he was approaching a grade crossing, which was obstructed with a Ford truck when he reached it. The foreman was bruised and cut, and both vehicles were damaged.

It is not possible to develop a set of rules or instructions that can correct accidents such as these. So we cannot expect the rules to be a cure-all; they merely point the way to develop "motor car consciousness" on the part of the operator. Assuming that a railroad has placed the operation of its motor cars in the hands of employees qualified as I have outlined, that the motor car is in a well-maintained condition, that it is equipped with safety devices and that it is the correct type of car for the work in hand, I believe that the solution for its safe operation can be found only in the efficiency and enterprise practiced by the supervisory officers.

Arc-Welding in Railroad Maintenance

By A. M. CANDY

Welding Engineer,
Westinghouse Electric & Manufacturing Co.

A discussion of the equipment characteristics that produce the greatest efficiency in the application of this method to repair problems on railroads

THE railroads of the country are pioneers in the extensive use of arc-welding equipment, particularly in connection with the maintenance of motive power. Several roads, moreover, have used arc-welding equipment in track maintenance work for a number of years and problems of bridge repair have also been solved by welding. The latter two fields have only recently been given serious consideration by many roads and a study of the available apparatus and some applications are, therefore, of timely importance.

Equipment for doing such work may be of several different types; to give the most satisfactory service it must provide the following features:

1—An easily manipulated arc
2—Constant current delivered through the arc
3—Simple control of the current delivered
4—High efficiency
5—Minimum weight
6—Suitable capacity of the equipment
7—Auxiliary power for grinders, etc.
8—Portability of the apparatus

An easily manipulated arc depends upon a number of generator characteristics. The open circuit voltage of the generator must be sufficiently high or the slope of the volt-ampere curve at arc voltage must be correct to permit the arc to be started readily when the electrode is touched to the work, even though the work may not be perfectly clean. The higher this voltage or the steeper the slope of the volt-ampere curve the easier it is to start the arc. However, the voltage must not, of course, be sufficiently high to produce a life or shock hazard to the operator.

For these reasons, therefore, the open-circuit voltages are usually between 45 and 90 volts. In the case of certain types of generators, the open circuit voltage has a direct bearing on the efficiency.

Constant Current Through Arc

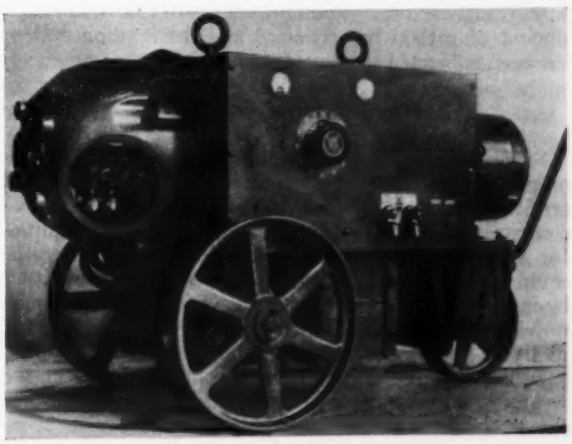
If welding is to be made easy for the operator and if the fusion of the work and welding wire is to be constant, the current delivered by the equipment must be maintained as nearly constant as possible at any desired current setting. However, it is not sufficient that the generator have satisfactory volt-ampere characteristics but it must be so designed that the current will be subject to a minimum transient change as sudden changes in arc circuit resistance take place. In welding, the arc resistance is continually varying over wide limits in very short periods of time. Therefore, the ability of a generator to accommodate its generated voltage instantly to just the proper value to deliver the desired current is of prime importance. In other words, its ability to limit the "surge" of current (when the arc is started) to a small percentage above the desired current is important. Likewise its ability to limit the "dip" of current (when the arc is suddenly lengthened) to a small percentage below the desired current is also important.

The effect of the "surge," when present, is to cause a splash of metal when the electrode is touched to the work to strike the arc. This characteristic is quite noticeable with certain generators. The "dip," however, is less noticeable but can be observed as a tendency for the arc to go out easily immediately following the "splash" as the operator separates his electrode from the work. Generators which produce the "splash" and "dip" effects also make it difficult for any but the most experienced operators to keep their electrodes from "freezing" to the work when starting to weld or when working under adverse conditions, such as in a wind or during cold weather when their muscular reactions are slow.

Simple Control of Welding Current

A single-operator generator, as shown in one of the illustrations, represents the ultimate in simplicity of control in that the entire range of welding current from minimum to maximum is determined by the setting of a single device, namely, the field rheostat. Since the operator always controls the arc voltage by the length of his arc, there is no necessity to provide him with any control other than that mentioned, which enables him to determine the current to be used.

A constant-voltage (multiple-operator type) generator is likewise very simple because the operator selects his



Example of a Single-Operator Welding Generator

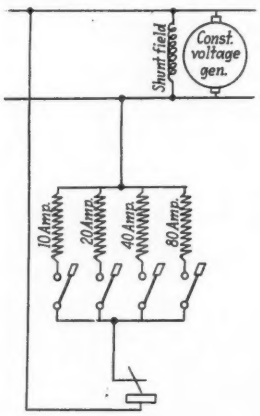
welding current by means of a series of switches controlling the amount of welding resistance used. The scheme of connections usually used is shown in the accompanying drawing. Using this scheme, it is possible to provide a total of 15 steps of current with 4 switches, 31 steps of current with 5 switches, or 63 steps of current with 6 switches.

If properly designed, there is very little difference between the weight of a single-operator welding generator plus exciter and Flexacter control, and the weight of a constant voltage generator plus its reactor and control. Furthermore, this equipment in either case represents only about one-fifth the total weight of a portable gasoline-engine driven outfit, including the auxiliary generating capacity required.

Capacity of Equipment

For welding purposes where only electrodes 3/16 in. or ¼ in. in diameter are to be used, the capacity of the welding generator need not be greater than 300-amp. However, if electrodes 5/16 in. in diameter are to be used or if power for carbon electrode work is required, a 400-amp. generator should be used.

Engines to drive welding equipment should operate at about 75 per cent of their rated capacity when the welding equipment and auxiliary generators, if used, are operating at maximum capacity. This reserve capacity is necessary for several reasons, the foremost of which is to enable the speed regulating governor to provide momentary reserve impulses to maintain good speed regulation when the load on the generator is suddenly varied. Also the engine should have some reserve when new to permit satisfactory operation even after a reasonable amount of carbon has collected and the ignition system has been subjected to some deterioration.



Showing the Hook-Up of Switches by Means of Which the Operator of a Constant-Voltage Generator Selects His Welding Current

Auxiliary Power for Grinders, Etc.

Since all built-up rail joints must be finished to the proper contour and since some occasions may demand artificial illumination for welding, it is desirable to have electrical capacity available in addition to that required for welding. In the case of single-operator generator equipment, such auxiliary power must be obtained either by increasing the size of the exciter, if one is used, or by providing an additional generator of the required capacity.

In the case of constant-voltage welding equipment, the welding generator may be increased in size to provide the necessary additional capacity or an auxiliary generator may be used. The former scheme will usually save some weight in the generating equipment but it has the following disadvantages: First, since such welding generators are operated at about 60 volts, all auxiliary equipment, such as grinders and slotters, must be provided with motors that will operate satisfactorily on about 55 volts, which requires larger, heavier and somewhat more special motors than where a 125-volt supply is available; second, the conductors used to carry power to such equipment must be twice as large in current-carrying capacity if the voltage drop is to be held at the same value as would result in a 125-volt system. Even then, the performance will not be strictly comparable because the percentage of the voltage drop is greater.

The actual auxiliary capacity required depends somewhat on the general scheme of operation, but experience has shown that 5 to 7½ kw. is ample for a single-operator unit. If a multiple-operator unit, with sufficient power for two welding operators is used, the auxiliary power capacity should be from 10 to 15 kw. to provide for equal service.

Operation of the Equipment

When a constant-voltage type of welding generator is used, the arc is stabilized and the current determined by resistance in series with the arc. This may be in the form of resistance tubes or grids or in the form of resistance in welding leads. One or the other is always necessary and, therefore, for a given welding current the power requirements from the engine driving the genator remain fixed.

In the case of a single-operator, inherently-regulating welding generator, the arc is stabilized by the design of the generator so that no external series resistance is necessary. Therefore, the generator never develops more power than that required by the arc and the welding circuit leads leading to the arc. If the arc is operated at 20 volts, 200 amp., and the welding circuit uses No. 0 cable, and the circuit length is 125 ft. (250 ft. of cable), the voltage drop in the cable will be 5 volts and the generator will operate at 25 volts. Likewise, if the circuit length is increased to 250 ft., the generator will operate at 30 volts.

Voltages, Circuit Lengths and Gasoline Used

Arc Amps. at 20 Volts	Generator Volts		Length Circuit Cable No. 0 Feet	Gallons Gasoline Per Hour		
				300-Amp. Gen. 55-hp. Engine		300-Amp. Gen. 30-hp. Engine
	Single Operator	Constant Voltage		Constant Voltage	Single Operator	Single Operator
200	25	60	125	4.16	3.38	2.30
200	30	60	250	4.16	3.6	2.38
200	35	60	375	4.16	3.72	2.45
200	40	60	500	4.16	3.94	2.56
200	45	60	625	4.16	4.02	2.61
200	50	60	750	4.16	4.10	2.74

Effect of Increasing Length of Circuit

The accompanying table shows the various voltages at which the single-operator generator will be forced to operate as the circuit length increases, and also the increase in fuel consumption of the engine as the power requirements increase. It is interesting to observe that when the circuit length has been increased to 750 ft., the fuel requirements with the 55-hp. engine are about the same as for the 60-volt constant-voltage equipment. However, by cutting out all resistance elements, the constant-voltage equipment will deliver 200 amp. for a 1,000-ft. circuit. On the other hand, a lead can be brought out from the junction of the armature and series field connection which will permit of operation at 1,000

ft. with the single-operator equipment the same as with the constant-voltage equipment.

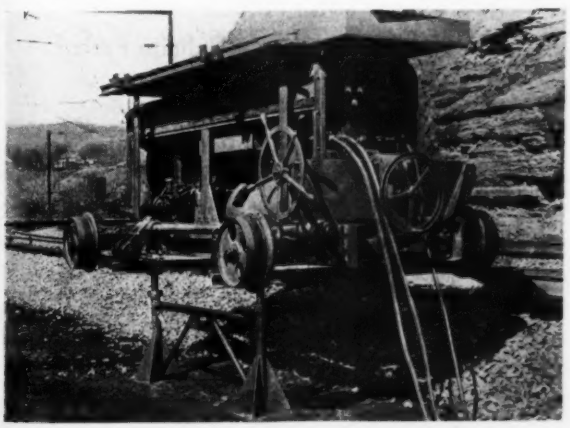
From this analysis it is evident that the greatest economy results from the use of the single-operator equipment, employing welding circuit leads in lengths that can be changed readily so as always to use the shortest circuit possible. On the other hand, the efficiency of the constant-voltage equipment cannot be increased by shortening the welding circuit because as cable is cut out, resistor elements must be cut in to maintain the balance difference between arc volts and generator volts.

Portability of Apparatus

To be most satisfactory, welding equipment must be constructed so as to be readily portable. The extent to which it is economical to provide portability depends largely upon the topography of the property where the equipment is to be used.

One type of equipment is illustrated below. It includes a six-cylinder gasoline engine, a 300-amp. single-operator welding generator, and a 7½-kw. auxiliary generator for welder excitation and power for grinding. The equipment weighs 6,000 lb. complete and is designed to be towed on the track. For removal from the track, auxiliary rails are laid across the track rails in line with those shown under the equipment on the jack-stand. One or the other of the hand wheels rotates two shafts carrying double-flanged wheels down against the auxiliary rails, thereby lifting the main running wheel flanges in the clear. A less expensive scheme involves the use of a crow bar at each wheel arm to raise one corner at a time.

Another type of equipment, shown in the next column, includes a similar engine and welding generator with a 5-kw. auxiliary generator, and two propulsion motors to



This 200-Amp., Single Operator Welding Generator Is Powered With a 6-Cylinder Gasoline Engine

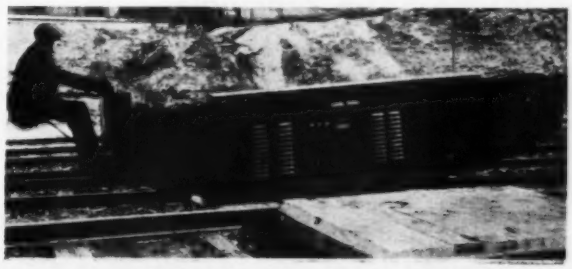
drive the two crawler treads so that the equipment can be moved under its own power. This equipment weighs 10,400 lb. complete and provides for the use of short welding cables as the outfit can be moved readily from point to point. After a joint is completely built up, it is necessary to grind it down to the proper contour, and the proper space or clearance between rail ends must be established.

The main surface grinding is performed with a reciprocating grinder driven by a three-horsepower motor taking power from the auxiliary generator. Several types of grinders are available for slotting the metal between the rail ends. On some properties the slotting operation is performed with a wheel about ⅛ in. thick. This is followed with a wheel about ¾ in. thick which has a 90 deg. V-edge which bevels the two ends of the deposited metal so that if the rail expansion closes the joint, there will be no concentration of load on the metal that has been applied by welding.

Application of Equipment

Equipment of the general type described above can be used for building up battered rail ends of either the carbon-steel or the non-magnetic manganese type. The repair of switch points, manganese frogs and crossings is also a very profitable maintenance application.

In the field of bridge repairs, equipment of the type shown below at the left is applicable, since, for this



A Welder Mounted on Crawler Treads

work, self portability is of no real consequence. Bridge repairs may extend from the simple replacement of a few corroded members to a job involving complete rehabilitation to increase the life and load-carrying capacity of the entire structure.

According to service-life records, built-up rails are showing a life of six to eight years, or stated in another way, the life of rails is practically doubled by the first welding. Furthermore, there is every reason to believe that the rails can be built up successively until the main portion of the rail depreciates to a point where replacement is required.

Repairing Special Trackwork

In special trackwork, one Class II eastern railroad reports that eight manganese steel crossings in a double-track main line intersection were repaired in July, 1931, requiring three days. In February, 1932, these crossings were again reconditioned, requiring three days for one welder and a helper. These eight crossings, which were installed in 1925, are now in excellent condition after eight years of heavy main-line traffic. The total cost of maintaining the crossings has been less than $300 or 20 per cent of the original cost of a single crossing while replacement of the crossings would have required an investment of $12,000. If these crossings had not been repaired, the maximum life would have been six years.

Costs in the field of bridge repairs vary over wide limits owing to the variations in the extent of the repairs and the sizes of the bridges. However, quite extended experience has shown that repair and strengthening operations can be carried on in the field by welding at a fraction of the cost of riveting, owing to the elimination of the necessity for drilling holes for field rivets. Furthermore, in many cases additional strength can be added to members by welding where it would be impossible to do riveting work. For example, additional cover plates can be added to the top and bottom flanges of box girders where it would be a major operation to arrange for driving rivets.



What's the Answer?

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions that you may wish to have discussed.

Tie Renewals

Should a definite period be allotted for making tie renewals, or should they be made, as convenient, throughout the entire working season? Why?

Should Follow a Definite Schedule

BY E. L. CRUGAR

Chief Engineer, Wabash, St. Louis, Mo.

It is desirable that all parts of a railway be maintained in the same general condition, so far as this is practicable. For this reason, a definite program of tie renewals should be followed over an allotted time. When a fixed period is set aside for this task, every one connected with the work in a responsible way, from section foreman to head of the department, will be interested in providing the materials necessary, including ties, tie plates, spikes, etc., so that the renewals may proceed regularly and be completed on all districts of the road at about the same time. By programming the work, the foremen are able to organize their gangs, and by concentrating on the task, the men become accustomed to working together and the operation is carried out more efficiently.

In allotting a period for tie renewals, the early part of the working season should be selected. Such surfacing as is done prior to the making of renewals is of temporary benefit only, since the same track must be gone over again after the ties are inserted. It is essential, therefore, that the ties be inserted in advance of any general surfacing.

In sections of the country where the working season extends from about April 1 to November 1, not less than 85 per cent of the tie program should be completed by July 1. Ballast works more freely in the spring, and since the weather is generally cooler, a greater production per man-hour can be expected than during the hot summer months. Again, unless care is exercised when renewing ties in extremely hot weather, the track may buckle. This danger is avoided by making the renewals early in the year. Exceptions should be made only to conform with definite ballasting or rail-renewal programs. Where these classes of work are in progress, tie renewals should be made as they progress.

During the period when tie renewals are in progress, the riding condition of the track should be watched closely by the roadmaster. If any part of the track shows signs of becoming rough as a result of the insertion of the ties, the renewal program should be suspended temporarily to enable the section forces to do the necessary smoothing. If substantially all of the ties are in by July 1, the section forces will have ample time during the remaining months of the season to surface and do other general maintenance work.

To Be Answered in July

1. When renewing rail with the same section, where double-shoulder tie plates are in use, should one or both lines of spikes be pulled? Why? If only one line, how can the old rail be removed? How should the new rail be laid?

2. What methods should be employed to replace loose or broken slate in a slate roof?

3. Should the right of way be mowed more than once in a season? Why? If so, when should each mowing be done? Should it be burned after each cutting? Why?

4. Should the heartwood of a treated bridge stringer be placed up or down? Why?

5. What preparatory work should precede the lining of track? Why? Which items are essential and which non-essential?

6. Under what conditions should water for locomotive boilers be filtered? When is it not justified? What are the advantages?

7. In view of the reduced maintenance of the last four years, should ties be dug in or should the track be given a light raise in connection with tie renewals? Why?

8. Where a pipe culvert pulls apart so that one or more joints are opened, what measures can be taken to correct the trouble?

Better Not To Have a Definite Period

By HENRY BECKER

Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

My experience has led me to the conclusion that it is better not to allot a definite period within which all tie renewals must be completed. A far more satisfactory arrangement is to insert the ties as convenient in connection with other work during the entire season, at least as late as weather conditions will permit. Not infrequently when a definite time for completing the renewals is specified, wet weather so interferes with the work that it is not practicable to proceed according to schedule; or if this is done, churning track results. This makes the track conditions worse and piles up more work than if the renewals are deferred until the weather is more settled. It is true that some of the ties will be put in late, but, taken as a whole, the track will be better and the work made lighter.

More Convenient to Renew Throughout Season

By GEORGE M. O'ROURKE

District Engineer, Illinois Central, Chicago

So many uncertainties affect plans for making tie renewals during a definitely allotted period that we find it more convenient to spread the renewals over the entire working season. Tie renewals in sidings and yard tracks can be made early in the spring before we dare disturb the main tracks, or late in the year after main-track renewals are completed. Main-track renewals should be started as early as practicable, immediately upon the com-

pletion of the early spring smoothing and lining, and should be followed through to early completion, to allow the longest possible time before winter for smoothing, lining and ditching. This is the best time, whether spotting, renewing out of face or applying the ties while surfacing.

An early start and early completion of the tie renewals saves the men from the heavy, tiring work of handling the ties during the hottest months of the year and also minimizes the hazards of buckling track. However, traffic and financial prospects during the early months of the year sometimes preclude extensive renewals at the beginning of the season and it then becomes necessary to defer the work and disturb the track later in the season when it should be getting well settled for winter. The allotting of a definite period for tie renewals is the ideal arrangement for this work, with ample labor and material to insure uninterrupted progress and early completion, but the ability to carry out such a program has not been possessed by many railways in recent years.

Best Practice Is To Get Ties In Early

By O. H. CARPENTER
Roadmaster, Union Pacific, Rawlins, Wyo.

Where climatic conditions make the winters long and severe and the working season short, it is essential that tie renewals be completed early, by July 1 if practicable, or by August 1 at the latest. The time that can be spent on tie renewals during this period depends, however, on the condition of the track after a severe winter and the amount of other maintenance work that must be done. There is always a considerable amount of rough track after a severe winter, and as the frost leaves the ground there is a marked tendency for it to get out of line. Obviously, smoothing and lining must be given preference, but the ties to be renewed should be marked and the new ties distributed accurately and placed ready to be inserted before the frost goes out. This will permit the renewals to be started as soon as practicable and pushed to completion without interruption, so far as waiting for or unloading material is concerned.

For a month or two after the frost goes out, the ballast in the cribs and on the shoulder is loose and easily worked, so that more work is accomplished per man than later, while the cooler weather also increases production. Again, at this season there is less danger of "humping" the track. The primary reason why early completion of tie renewals is desirable, however, is that time is left for the ties to become firmly seated before winter sets in. In addition, the section gangs can devote the latter part of the season to improving surface and line and to putting the track in the best condition to enter the winter season. Recently we have adopted the practice of employing a specially organized tie gang on each roadmaster's district to make all tie renewals. This leaves the section gangs free to follow up and care for any inequalities of line and surface that may result from the renewal of the ties. So far this plan has been very satisfactory.

[Answers to this question were also received from W. E. Tillett, section foreman, Chesapeake & Ohio, who favored making the renewals according to a schedule that will insure early completion of the program and leave sufficient time to apply to other features of maintenance; from L. A. Rape, section foreman, Baltimore & Ohio, who also favored a definite schedule, but thought the allotment of time should be left to the local officers because they are more closely in touch with local conditions; and from W. H. Sparks, general inspector of track, Chesapeake & Ohio, who expressed the belief that where the renewals are light, say, as a result of the use of treated ties, the work can be spread over most of the working season. Where rail is being laid or ballast renewed, the tie program should conform to the progress on these projects. Elsewhere, the work of renewing ties should be deferred until the roadbed is settled after the frost goes out, but should be completed as early thereafter as practicable.—Editor]

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Repairing Concrete

Where concrete in a locomotive coaling plant or other structure having thin sections is damaged or deteriorates so that the reinforcement is exposed, how can repairs be made?

Success Depends on Bond

By A. C. IRWIN
Manager, Railways Bureau, Portland Cement Association, Chicago

This question does not involve unusual conditions, and the method of repair should be the same as for other structures having like defects. There is an inference that locomotive gases may be the primary cause of the trouble, but these gases are so diluted that, although they may aggravate the corrosion of the reinforcement, they are not likely to damage the concrete, and the basic cause of the deterioration lies in the manufacture of the concrete. If the bars are in a main member carrying design loading, additional bars should be supplied where the section of the original bars has been reduced to ¾ of their section when new.

Success of the restoration depends on the bond of the patching material with the old concrete, and the principles underlying such bond should be understood by the *workmen*, not merely by the engineer or specification writer. Bond is derived in part from molecular adhesion, and more particularly from the grip of the projections, large and small, of the old concrete as a result of the hardening of the cement paste in intimate contact with the old concrete. This leads at once to the principles governing bond:

(a) The old surface should be rough, the optimum condition being a multitude of small protuberances rather than a relatively small number of large ones; (b) the new concrete should have intimate contact with all of the surface of the old concrete, including the depressions; (c) the new concrete must have an opportunity to attain a high degree of strength.

Instructions may now be written as follows:

1. Remove all deteriorated and/or loose material. Clean bars of rust.
2. Clean all soot, dirt, etc., from the old concrete and roughen the surface by light picking. A mason's crandal is a good tool, if used with light strokes. Aggregate should not be broken or loosened in the process of roughening. Acid treatment, properly done, is satisfactory [Principle (a)].
3. Restore the required section of reinforcement, if necessary, carrying the new reinforcement to each side of the weakened length of old reinforcement to develop by bond the full strength of the new reinforcement.
4. Soak the area of the old concrete that is to be patched, with water. Otherwise, if the old concrete is dry and absorptive, it will quickly take the water from the new concrete in contact with it and may make proper hardening impossible at this critical place, thus destroying any hope of proper bond [Principle (c)].
5. When the old surface is free from excess surface moisture, apply the patching material, preferably by throwing, although packing and ramming it in the forms may accomplish the desired results. If more than one coat is applied, the first one should be a relatively rich mix and of a plastic consistency. Nothing should be done to this coat that will disturb the intimacy of its

contact with the old concrete [Principle (b).]

6. Keep the new concrete continually moist for three days or more, depending on the temperature. A shorter curing period is satisfactory with high early strength cement [Principle (c)].

What might be termed the "dry cement method" of obtaining bond requires a clean receiving surface that has been saturated with water. While still wet, spread or dust on dry cement and work it thoroughly with a wire broom or brush. Allow to dry until sticky or "tacky" and apply the patching material in accordance with Rule 5. In this method the dry cement uses the surface water for hydration and the brushing or brooming works it into close contact with the old cement.

Three Items of Prime Importance

By Supervisor of Bridges and Buildings

Three things are of primary importance in repairing damaged or deteriorated concrete: (1) the bond between the new and old concrete; (2) the consistency of the new concrete; and (3) proper curing. To secure proper bond, the surface to be repaired should be rough and a bonding coat consisting of one part of cement and one part sand mixed to a plaster consistency should be spattered against this surface with enough force to insure an intimate contact over the entire area. The surface should be thoroughly moistened by being kept wet for at least one hour prior to the application, but should be allowed to dry until it is merely damp before the work commences. The bonding coat should be mixed at least one hour before it is used.

Since the new concrete should be well compacted, the consistency should be such as to permit the maximum degree of compaction. For this purpose not more than six gallons of water should be used to the sack of cement, and the water-cement ratio should be still lower if practicable.

To insure proper curing, the surface of the new concrete should be kept wet for at least three days and measures should be taken to prevent it from becoming dry for at least four days more.

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Painting Tanks

What is the most practicable method of providing staging for painters engaged in painting wooden tanks? Steel tanks? What precautions should be observed?

Scaffold Should Conform To Arc of Circle

By H. CUNNIFF

General Painter Foreman, Delaware & Hudson, Green Island, N. Y.

From long experience in erecting staging for painting water tanks, I believe that the swinging scaffold is the safest as well as the most practicable. Many advantages accrue from the use of a light scaffold so constructed that the safety factor is well provided for. Made of selected eastern spruce, in the form of an arc of a circle having a radius of 37 ft. 8 in., a scaffold 10 ft. long and 2 ft. wide will weigh about 70 lbs. We suspend it with 6-in. double blocks using ⅝-in. rope, from scaffold irons placed 18 in. from the ends. Scaffold roof shoes are also desirable, since they may be tied back close to the end of the cornice by using the center post as an anchor. Where there is no center post, the tie ropes may be extended across the roof to a point opposite the scaffold, where small hooks may be dropped over the edge of the cornice. Cross-tie ropes must be used, however, to prevent spreading. Two men can readily work from such a scaffold, covering from 12 to 13 ft. in width to the drop of the scaffold. In the event that extensive repairs require the erection of platform staging, the painting forces should take advantage of this construction to do the painting.

Swinging Scaffold Most Economical

By E. C. NEVILLE

Bridge and Building Master, Canadian National, Toronto, Ont.

I have found the swinging scaffold to be the most economical as well as the most practical staging for painting both steel and wooden tanks, because of the ease with which it can be put up and moved around the tank. An easy method of erection is to use a light steel cable of suitable length, looping it at the middle around the base of the indicator pole where it projects through the center of the roof, clipping it so the loop will fit loosely. Loops should then be formed at each end of the cable which should extend to the edge of the roof. Blocks and falls can then be hooked to both the scaffold on the ground and into the loops at the ends of the cable. The workmen can then adjust the scaffold to any height or lower it to the ground for shifting further around the tank. In some cases one-man scaffolds or painter's chairs, such as flag pole or smoke-stack painters use, will be found more convenient. In such cases the same method of support can be employed as is suggested for the scaffolds.

There Is No Well Established Practice

By C. R. KNOWLES

Superintendent Water Service, Illinois Central, Chicago

There is no well established practice in providing staging for the painting of either steel or wooden tanks, since methods vary on different roads, being governed largely by the facilities at hand. In some cases steel tanks are equipped with full-revolving ladders from which the painting can be done. In others falsework is erected to support staging; while in still others a boatswain's chair is employed.

Probably the most convenient and economical method is the use of a seat or stage that is supported by means of painters falls. These consist of two pairs of wooden-shell tackle blocks, each having one single block with becket and one double block without becket, reeved with manila rope spliced into the becket of the single block. Where a seat instead of a stage is used, a single pair of blocks is sufficient. The difficulty in using a double pair of blocks with staging is that trouble is experienced in swinging the falls far enough from the edge of the tank to serve a stage of the required length. This can be overcome, however, by the use of a special jack or scaffold iron instead of the usual painter's cornice hook, which will allow the falls to swing out from the edge of the staves. The scaffolding may be swung from either the pinnacle of the tank, with lines passing over the edge of the roof, or it may be swung directly from the staves of a wooden tank or the rim of a steel tank.

Spray painting simplifies the problem of scaffolding, since extension spray guns six to eight feet long can be used to paint beyond ordinary reach.

Every precaution should be taken to avoid accidents in painting tanks. Where falls are employed, the staging or chair is raised and lowered by the workmen. In every case, however, it is wise to have a man on the ground as a safety measure, and to handle material. Where cornice hooks or scaffold irons are attached to the top of the staves of wooden tanks, every precaution should be taken

to know that the staves are sound and that the hooks will not slip or pull through the staves. Where vertical ladders are utilized, the painter should secure himself with a safety belt. Ladder jacks should be used when scaffolding is swung from ladders.

The same rules apply to the painting of tank interiors. The maximum corrosion on the interior of steel tanks usually occurs, however, within the limits of the upper rings where the plates are alternately wet and dry. To avoid taking the tank out of service it may be desirable to confine the painting to this area, in which case a floating platform can be made out of planks and kegs, if the height of the water in the tank is controlled.

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Line First or Gage?

Should track be gaged before or after it is lined? Why?

Gage Immediately Before Lining

By H. F. FIFIELD

Engineer Maintenance of Way, Boston & Maine, Boston, Mass.

If both gaging and lining are necessary, the gaging should be done immediately before the lining, if practicable. If gaging is to be done during the winter, the track should be carefully lined in the fall before frost sets in, as it is impossible to hold it to proper line, especially where speeds are high, if the gage is irregular.

Should Always Gage First

By L. A. RAPE

Extra Foreman, Baltimore & Ohio, Ribold, Pa.

Track should always be gaged before it is lined, if a good line is to be maintained in both rails. The high rail on curves is generally forced out, thus widening the gage. If the curve is gaged, much of the irregularity of the line will be eliminated and the lining will be reduced correspondingly. If the lining is done first, it will be more difficult because this rail is loose in the spikes, besides which it is probable that it will be necessary to line again after the gaging is completed. To only a less degree, the same is true on tangent.

There Is Disagreement On This Question

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

I have found considerable disagreement among experienced trackmen as to which is better, some holding one way, some the other. Every aspect of the problem should be considered, however, before drawing a conclusion. In general maintenance as well as in the larger projects, such as ballasting, the lining of the track is the last operation performed, except the dressing of the ballast section. In such cases, it is obvious that the gaging should precede the lining.

Where track is being worked out of face, old ties are removed and new ones inserted. The remaining serviceable ties are straightened and spaced, usually to the detriment of the gage. All new ties must be spiked to gage and this necessitates the adjustment of the gage on all ties, which should be spiked securely before surfacing is started to insure that they will remain in their proper place during this operation. The same is true to only a less degree in ordinary tie renewals.

Where track is being lined independently of other work, if the gage is irregular, it is almost certain that the rails are loose in the spikes. If this is the case, they will not stay in position after they are lined. For this reason, the track should be gaged and all of the spikes driven to a snug fit before the lining is started.

Depends on How Wide the Gage Is

By W. E. TILLETT

Assistant Foreman, Chesapeake & Ohio, Maysville, Ky.

If the track that is to be lined is on a curve or the gage is very wide, the lining should be done first. By lining such track first, the line rail will be put in good shape and the gage rail will be in as good line. If the gaging is done first, however, a certain amount of kinking will occur in the gage rail which can be eliminated only by easing the spikes and adjusting the tie plates accordingly.

My experience is that the lining can be done with less effort also. On the other hand, if the track is only slightly out of line, it is practically certain that the gage is not very irregular, and it is better to do the gaging first, as later adjustment of the gage and tie plates will not be necessary. If the track is laid with light rail and no tie plates, the gaging should be done first.

Good Gage Necessary To Good Line

By V. H. WARD

Extra Foreman, Chicago, Burlington & Quincy, Brush, Colo.

If the surface and gage are up to standard, both rails will stay in line with more tenacity than is generally realized. If the gage is wide or irregular, neither line nor surface can be maintained. Assume that in sighting down one rail it is observed that a joint, a center or perhaps an entire rail is out of line, but that the opposite rail is perfectly straight, although immediately in advance this rail is as badly out of line as the first one which, directly opposite, is straight. Every trackman knows that in such a situation no amount of lining will bring both rails into a true line, and that unless this is done, the energy applied in the effort to do so will be wasted, for the irregular line in both rails will quickly return. On the other hand, if the gage had been used before lining to bring the wide places in to standard, most of the lining would have been unnecessary and both rails could thus have been brought to a nearly true line, while the time wasted in trying to do the impossible could have been applied productively.

Gage and Line Are Closely Related

By Engineer Maintenance of Way

In discussing this question, it is assumed that the track is fully tie plated, as is the practice on most Class A roads at present. Good gage and line are so closely related and mutually dependent that any statements with respect to precedence in the sequence of operations must be made and accepted with certain reservations.

From my own experience, when track is not undergoing general repairs, if both gage and line are only slightly imperfect, and the line rail, tie plates and spikes thoroughly settled, in proper contact and fit with the rail base, it is generally preferable to gage before lining. If the line is very kinky and otherwise irregular, however, it is my experience that better, but more costly, results can be obtained by lining first, then adjusting all tie plates and spikes on the line side to bring them to proper position. After this is done, the gaging should be undertaken. This sequence of operations eliminates short line

kinks which are necessarily reflected in subsequent gaging, which kinks the heavier track material now so nearly in universal use has made difficult to overcome without disturbing the proper fit of the tie-plate shoulder to the rail base when lining track.

[This question was also discussed by O. H. Carpenter, roadmaster, Union Pacific, who said that gaging should, in general, be a winter job, so that there should be no necessity for gaging at the time the track is lined during the following season. He said that "irregular line has no effect on the quality of the gaging, but irregular gage has a distinctly bad effect on line as well as lining." Henry Becker, section foreman, St. Louis-San Francisco, who also discussed this subject, said that "where the track is not to gage, even the most experienced trackman cannot line to advantage."—Editor]

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Leakage Around Drainage Openings

What precautions should be taken to prevent leakage around drainage openings through waterproofed surfaces?

Proper Materials and Intelligent Workmanship

By DAN MACK
Architect, Delaware, Lackawanna & Western, Hoboken, N. J.

Fundamentally, the precautions that should be taken are those that insure a tight joint between the concrete and the drainage pipe and an unbroken continuity of the waterproofing, and this can be attained only by a careful selection of the waterproofing materials and equal care and intelligence in workmanship. In selecting the drainage pipe, that type should be chosen which has proved to be adapted particularly for the conditions that must be met. For instance, if the drainage is to be taken from the track bed or other surfaces where cinders and coal dust may be expected to accumulate, a cast iron pipe is preferable, since it will have a longer and more satisfactory service life than either steel or wrought iron, owing to its greater resistance to corrosion. The pipe should be of ample size, with a minimum of 4 in., while 6 in. to 8 in. is advisable under certain conditions.

Strainers should be provided to prevent clogging by ballast, gravel or dirt. Where the pipe is set in the forms, to be enclosed in concrete and the concrete has shrunk slightly away from the pipe, the space between the two should be calked thoroughly and filled with an elastic filler. This precaution is also necessary where the pipe is placed after the concrete has hardened. We prefer to use pipe with the bell end up, where practicable, since it is possible to return the waterproofing unbroken into the bell and make a proper application below the concrete surface.

Drainage Openings Often Give Trouble

By Engineer of Design

Drainage openings in waterproofed surfaces are often the weak spots in an otherwise satisfactory waterproofing application. This is not always the fault of the waterproofing itself, however, since the trouble may arise from improper design of the drainage casting or failure to provide a free outlet for disposing of the water that is to be drained away. One of the first requisites of proper drainage, here as elsewhere, is a free outlet. To obtain this, the pipe should be straight and of ample size to insure against clogging with dirt, cinders, ballast or other debris, or with ice during seasons of alternate freezing and thawing. If a change in direction is necessary, clean-out openings should be provided at every bend.

Drainage castings should be carefully designed to receive the waterproofing and should have strainers to keep out all of the coarser materials and as large a proportion of the smaller sizes as is consistent with the free flow of the drainage water. The water should get away quickly, for slow seepage may be disastrous. The drainage casting should be anchored rigidly into the waterproofed surface, for movement may mean failure of the waterproofing. If there is an open space, no matter how small, around the outlet through which water may find its way, it should be sealed, and calked if necessary.

These requisites having been met, extreme care should be exercised to insure that the waterproofing adheres to the surface for some distance around the opening and is turned without a break into the drainage casting, to the surface of which it should also adhere. Poor workmanship at this point may nullify all other precautions, no matter how carefully they may have been observed.

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Wear in Wire Rope

How frequently should wire rope used in hoisting equipment be inspected? What are the indications that determine when replacement shall be made?

Weekly Inspection Should Be Made

By A. N. REECE
Chief Engineer, Kansas City Southern, Kansas City, Mo.

Where wire rope is in generally continuous service, weekly inspections should be made, especially after the rope has been in service for some time. Whenever equipment using wire rope has been laid up, the rope should be inspected carefully before it is returned to service. Broken wires and frayed cables indicate a worn cable and the rope should be replaced when in this condition. If the rope is being used in heavy loading, replacement should be made as soon as broken wires appear as a result of wear. The man in charge of the work should keep himself informed of the condition of the rope at all times, and see that replacement is made before there is any doubt as to its safety for the work in hand. Wire rope should be lubricated for better working on the sheaves and to prevent rust. It must be kept free from kinks and wound smoothly on the drum. It must also be used with the proper size and pattern of sheaves to obtain satisfactory service.

Inspection Should Be Frequent

By Supervisor of Bridges and Buildings

Wire rope that is carefully selected as to size and type for the work in hand; that is run over sheaves of correct design and size; and that is used properly by the operator, will have a surprisingly long life. When it is new, a weekly inspection should be sufficient. As its service life is extended and signs of wear appear, careful inspection should be made oftener. In any event, the operator should know at all times exactly what its condition is, but this should not relieve the foreman of responsibility for knowing its condition from personal observation.

Two things clearly indicate approaching failure and the early, if not immediate, need for replacement. Badly worn strands are generally the prelude to broken wires.

As soon as they occur, replacement should be made without delay. If the rope has been misused in any one of several ways, mashed places may appear, and later the strands may fray and the individual wires break. In this case also, renewal should be made at once.

Rope Should Be Used Carefully

By General Inspector of Bridges

As concerns safety, probably more depends on the wire rope of hoisting equipment as it is ordinarily used than on any other item. Yet, in many instances, no other part of this equipment is used with less caution. Not infrequently, it is run over sheaves of improper design or of a size not suited for the particular rope. If the rope does not fit the groove, damage is sure to occur. If the groove is too narrow, the wires wear rapidly and break; if too wide, the rope flattens and eventually fails from this cause.

Some operators have a habit of picking up the load with a jerk or of dropping it rapidly and catching it just before landing it. This brings an undue strain on the line, even if it is not loaded to capacity. When worn, the danger of breaking some of the wires is greatly increased.

For these reasons, both operator and foreman should know at all times exactly what the condition of the rope is. With a new rope, a formal inspection should be made at least weekly, and as the rope wears this interval should be shortened. At the first indication of failure, the worn rope should be replaced with a new one, and the sheaves should be examined to insure that they are not in condition to damage the new rope.

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Insulated Joints

What precautions should be observed in applying and maintaining insulated joints? Why?

Insulated Joints Require Special Technic

By Engineer Maintenance of Way

Insulated joints serve as rail fastenings as well as to insulate track circuits. For this reason, although special precautions are required in their application and maintenance, some of the precautions that should be observed are of equal importance in connection with ordinary joint bars. Probably the most common fault of trackmen is carelessness in assembling and applying the various parts of the joint and in its later maintenance. This is usually reflected in early failure of the joint or some of its parts, as compared with longer life and more satisfactory performance of a similar joint properly applied. This offers an excellent example of a little carelessness creating a large waste.

To begin, since clean smooth bearing surfaces are necessary to a good fit, which will avoid distortion and reduce wear, all scale, dirt and other foreign matter should be removed from the rail and the various parts of the assembly. For the same reason, burrs, rough edges and other sharp projections which may cut or abrade the insulating fibre should be filed off to insure smooth surfaces in contact with the insulation. This leads to the warning that the cut end of the rail, unless it has been sawed, should never be used in an insulated joint, as the rough surface will damage, if not destroy, the fibre end post. Again, hand-drilled bolt holes are seldom spaced accurately, and this may also cause damage to the bushings for the bolts.

Insulation should always be kept clean and dry when not in use, since insulating fibre is quickly ruined by moisture unless it is kept under relatively heavy compression.

An insulated joint should never be applied to rails with battered ends. One of the requisites of such joints is that there shall be no relative movement between the parts under passing wheels. It is impossible to keep battered joints tight, and the fibre is soon crushed by the pounding it receives. All expansion gaps should be no wider than necessary for easy insertion of the end post. If it is wide, the rails should be driven to close it, but not hard enough to crush the fibre; if it is too narrow it should be widened the proper amount. Do not try to drive the fibre into a space too small to hold it. Likewise, do not drive a bushing into place or a bolt through the bushing. If the rails are properly spaced, both the bushings and the bolts can be inserted by hand without damage.

End posts are made for full rail sections. If the rail is worn, the end post will project above the running surface and be mashed and frayed by the first wheel passing over it, thus allowing water to seep in and soften the fibre. To avoid this, the fibre should be trimmed neatly and smoothly to bring it flush with the running surface as soon as it is inserted.

After all parts are in place, the bolts should be tightened a little at a time, keeping the center bolts slightly in the lead. The bolt heads and the flanges of the joint bars should be tapped lightly as the tightening proceeds, to insure that all parts will be brought to an even snug fit. Heavy blows should never be permitted. Even when the tightening is done properly, insulated joints do not come to a tight fit for some time. It is advisable, therefore, to go over them, daily for two or three days, tightening the bolts and repeating the light tapping each time, and then repeat this attention at longer intervals for two or three weeks.

It seems trite to say that bolts should be kept tight, that ties should be sound and that the joints should be maintained to a good surface, with clean ballast and free drainage to eliminate churning. These precautions are more important, however, for insulated joints than for those of the ordinary type.

Insulation Does Not Stand Rough Handling

By H. E. HERRINGTON

Section Foreman, Minneapolis & St. Louis, Jordan, Minn.

Insulating fibre is molded to fit the particular section of rail for which it is intended and should, therefore, never be used on another section, even though the difference may be slight. Since its purpose is to insulate the track circuits, every part of the joint assembly should be in place, to avoid the possibility of steel-to-steel contacts and consequent leakage of the current through the joint.

Insulating fibre does not withstand rough handling and is damaged by moisture. For this reason it should be kept dry before application and handled carefully in making the installation. It is not good practice to force any of the parts in place, as they can be applied without damage if the rails are in proper position relative to each other and by the exercise of a little patience. After application, the bolts should be kept tight and the joint to surface on a sound tie which has a solid bearing. The ballast should be cleaned and well drained as movement in the joint creates wear that is fatal to the service life of the insulation.

[Replies to this question were also received from W. E. Tillet, assistant foreman, Chesapeake & Ohio; from V. H. Ward, extra foreman, Chicago, Burlington & Quincy, who called attention to the fact that light tapping at the base of the angle bar is necessary to an even bearing of all of the parts and to avoid the "cocked" position which is found so often in improperly applied joints; from L. A. Rape, extra foreman, Baltimore & Ohio, who cautioned against using a chisel to force rail ends open; and E. F. Schemerhorn, manager rail joint department, Rail Joint Company, who gave a comprehensive discussion that, because of space limitations, was too long to be included in this department, but which will be published in a later issue.—Editor.]

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Independently Fastened Tie Plates

Where tie plates have fastenings independent of the rail, what form of fastening should be used for the tie plate? What form for the rail? Why?

Screw Spike Is Most Practicable

By H. S. CLARKE
Engineer Maintenance of Way, Delaware & Hudson, Albany, N. Y.

While a better method may be developed for securing the tie plate, the screw spike is probably the most practicable and widely used method at present. It is essential to restrict the motion of the plate on the tie, to do away with the rolling shear impact of loads and the mechanical rasping of the tie. The screw spike, properly driven and later tightened after the plate has taken its set under repeated loads, best accomplishes this. It is not practicable, however, with the standard screw spike and head to have it fit tightly in the hole in the plate, certain manufacturing tolerances being necessary.

The clearance may be minute to begin with, but with constant use wear eventually increases the size of the hole and decreases the size of the neck of the spike, finally making it necessary to regage the track. The present spike could be improved, therefore, by changing the design of the head to allow it to be tightened to compensate for this looseness.

In track construction in which the tie plates are fastened independently of the rail, by means of screw spikes or other devices, the former function of the track spike of holding gage is eliminated and another type of fastening for the rail becomes desirable, which will cause no damage to the tie and yet have sufficient holding power to eliminate creeping, with enough flexibility to avoid obstructing the wave motion of the rail and increase the movement of the tie in the ballast.

Tie plates should have flat bottoms and be canted and cambered. Camber, in itself, reduces the motion of the plate and the movement of the tie, particularly if the rail fastening is sufficiently flexible, as in the spring type. With such a plate there is a better load distribution; this applies to the entire time the plate is functioning, including the approach of the load, its application and recession. With such construction a double-shoulder tie plate is desirable, and this, in itself, acts in a measure as an anti-creeper.

Experience with upwards of 150 miles of track similar to that described indicates many benefits, such as the elimination of mechanical wear and spike killing of the ties; a decrease in the movement of the ties in the ballast; elimination of the necessity for anti-creepers; a reduction in rail batter; and decreased maintenance costs. It is unnecessary to leave the theoretical expansion openings generally maintained in standard track construction, because the holding power of the spring clips and the double-shoulder tie plates, together with the frictional resistance between the rails and ties, reduces the tendency of the rails to move in expansion and contraction with changes in temperature.

Uses Track Spikes To Hold Rail

By W. H. SPARKS
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

While a few roads are using track spikes to perform the function of an independent fastening for tie plates, I believe the practice of using wood screws is rapidly gaining favor and predict that, unless some better form of fastening is devised, it will become the universal method in a short time, because it holds the plate more rigidly to the tie and does not damage the wood as the track spike does. By reducing relative motion between the tie and plate, abrasion of the wood fibre is eliminated and ties do not plate cut as formerly.

We have had no experience with any form of rail fastening except the track spike, which we have so far found satisfactory. I am satisfied, however, that a better fastening can be devised, which will eliminate the damage now done to the ties by the present form of track spike. Such a fastening should add many years to life of our ties.

Rail Should Be Held Rigidly

By O. H. Carpenter
Roadmaster, Union Pacific, Rawlins, Wyo.

My observation leads to the conclusion that screw spikes give the best results as a means of holding the tie plate rigidly to the tie. Where the application is made properly the tie plates do not get loose, except through settling into the tie. In hardwoods this is nearly negligible and an occasional tightening of the screws will keep the plates tight. The crushing will be more pronounced in softwoods and the spikes must be run down oftener. In this case a high tension spring washer between the head of the spike and the plate is an advantage in overcoming the tendency of the plate to become loose and move relative to the tie.

If double-shoulder tie plates are used, the rail will be held to gage so that it needs to be held against vertical movement only. To do this some form of clip is practicable and has the advantage of eliminating the damage to the ties that occurs through the use of track spikes. If these are of the spring type a certain amount of latitude is permitted between the rail and the tie plate, yet the rail is held rigidly in position, with no apparent tendency to creep, slue the ties or shift in line. Gaging is practically eliminated, except on curves, where the necessity for it arises out of the side wear on the head of the high rail.

[This subject was also discussed by L. A. Rape, extra foreman, Baltimore & Ohio, who called attention to the practice too often indulged in of driving lag screws part way down with a hammer to get them started. This cuts down the effectiveness of the holding power of the screw and damages the ties. In his opinion, an ordinary track spike would be as effective and cause less damage. W. E. Tillett, assistant foreman, Chesapeake & Ohio, also sent in an answer, in which he mentioned the nearly noiseless track created by tie plates that are held down by lag screws, and the decreased tendency of the track to get out of gage.—Editor.]



NEW AND IMPROVED DEVICES

New Harnischfeger Crane Developed

A NEW tractor-mounted general-utility crane, which has been designated as the "Hustler," has been developed by the Harnischfeger Corporation, Milwaukee, Wis. Among the advantages claimed for this crane, which is convertible to use as a clamshell crane,



The New Harnischfeger "Hustler" crane

a dragline scraper or a pile driver or for tractor service, is the fact that it is capable of relatively high transporting speeds. What is said to be one of the unusual features of this crane is the flexible arrangement of the drums, there being two side drums and a front drum, all of which rotate independently. Each drum has three forward speeds and one reverse speed and when working conditions require, the boom, which is side mounted, may be changed from one side to the other by removing the pins at the foot of the boom. Loads may be lowered by power by throwing in the reverse gear.

This crane also has three traction speeds, a high speed of 5.2 miles an hour, an intermediate speed of 2.6 miles an hour and a low speed of 1.3 miles an hour. All gears are fully enclosed and run in oil. Roller bearings are used throughout the main machinery, while renewable bronze bearings are used in the traction mechanism. The friction clutches are of the large diameter band type.

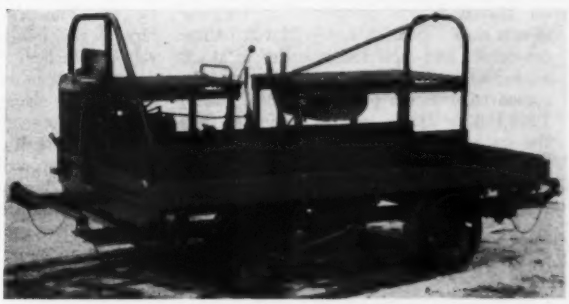
During tests it is said that the machine, with counterweight, lifted 12,000 lb. at a distance of 6 ft. from the edge of the traction crawler; without counterweight, 5,200 lb., 4 ft. from the edge of the crawler. With a detachable stiffleg under the boom, it is said that the machine will lift 35,000 lb. In lifting tests with a counter weight, it is said that the machine carried 12,000 lb. at a distance of 6 ft. from the edge of the traction.

New Fairmont Electric Generator Car

AN extra-gang and bridge-gang motor car, equipped with a built-in electric power plant with a maximum output of 6 kw. for furnishing power for the operation of electrical track and bridge tools, has been placed on the market by Fairmont Railway Motors, Inc., Fairmont, Minn.

This car, which is designated as the A37, supplies both direct and alternating current simultaneously. As the same power plant operates both the motor car and the generator, attention is directed to the fact that, in addition to eliminating the cost of transporting a separate gas-electric plant, the cost of a second engine to drive the plant is saved.

This car is powered with a 15-hp. 4-cylinder engine having light reciprocating parts and a ball-bearing crankshaft. The small bore and stroke of this engine are said to assure a high degree of fuel economy under all conditions. Power transmission is by four gear reductions,



The Fairmont A37 Motor Car With a Built-in Electric Power Plant

all of which are reversible, the power being changed from the car drive to the generating of electrical power by shifting the reverse gear to neutral.

The A37 car is said to have sufficient tractive power to haul 20 men and a trailer carrying 5,000 lb. It is equipped with retractable set-off wheels and cross-rails, which enable the car to be transferred to and from the track by one man. A deep deck tray, 32¼ in. by 95 in., is provided for carrying tools.



News of the Month . . .

New Freight Cars on Order Show Increase

On March 1 the Class I railroads of the United States had 5,019 new freight cars on order, as compared with 1,974 and 3,214 on the same dates in 1933 and 1932, respectively, according to reports compiled by the Car Service division of the American Railway Association. On March 1 the railroads also had 21 new steam locomotives and 90 electric locomotives on order with the manufacturers.

Expect Second Quarter Carloadings to Gain Over Last Year

Freight carloadings in the second quarter of 1934 will be about 10.7 per cent above actual loadings in the same quarter of 1933, according to estimates compiled by the thirteen shippers' regional advisory boards. On the basis of these estimates, freight carloadings of the 29 principal commodities will be 4,367,725 cars in the second quarter of 1934, compared with actual loadings of 3,945,568 cars in the corresponding period of last year. All the advisory boards expect increases in carloadings in their respective regions, as compared with the second quarter of last year.

Tie Stocks of Producers Show Further Increase

Reports filed with the Railway Tie Association by 14 companies supplying about 85 per cent of the ties produced by commercial firms show that the number of crossties held in stock by these companies on March 1 was greater than for any month since April, 1932. On March 1 these companies had 7,247,550 crossties in stock, an increase of 137,325, or 1.9 per cent, as compared with the previous month, and of 1,398,118, or 23 per cent, as compared with the same month a year ago. Tie stocks in the hands of these companies have increased continuously since last August when they reached the low point of 5,063,020 ties.

Casualties in Crossing Accidents Are Fewer in 1933

In 1933, for the fourth consecutive year, there was a reduction in the number of casualties resulting from accidents at railroad-highway grade crossings, with the result that fewer persons lost their lives in such accidents than in any similar period since 1916, according to reports made public by the Safety Section of the American Railway Association. Complete reports for 1933 show that 1,511 persons were killed in grade crossing accidents last year, a reduction of 14 as compared with 1932. Persons injured in such accidents in 1933 totaled 3,697, a reduction of 292 as compared with the preceding year. There were 3,235 accidents at grade crossings in 1933 as against 3,499 in 1932, a reduction of 264.

Rail Net for Two Months Shows Increase Over Last Year

Class I railroads for the first two months of 1934 had a net railway operating income of $60,209,882, which was at the annual rate of return of 1.99 per cent on their property investment, as compared with a net railway operating income of $23,718,787, or 0.78 per cent, in the same period of 1933. Operating revenues for the two-month period totaled $506,441,698, compared with $438,709,151 for the same period last year, an increase of 15.4 per cent. Operating expenses for the two months amounted to $384,440,777, as against $353,013,827 for the same period in 1933, an increase of 8.9 per cent.

Western Roads to Continue Reduced Passenger Fares Four Months

Western railroads will continue for another four-month period, terminating September 30, the reduced passenger fares established last December, it was decided at a meeting of the Western Association of Railway Executives in Chicago on April 6. According to Harry G. Taylor, chairman of the association, figures indicate the reduced fares have met with a favorable response from the public, and while revenues have possibly not been as great as was hoped for, the belief prevails that extension of the experiment is warranted. The general basis of the reduced fares is as follows: 2 cents a mile one way in coaches; 1.8 cents a mile each way for round trips in coaches; 3 cents a mile one way in sleeping cars; 2 cents a mile each way for round trips in sleeping cars, with a 10-day limit; and 2½ cents a mile each way for round trips in sleeping cars with longer limits. The western lines have named a committee of presidents to confer with similar groups from the east and south in an effort to bring about the adoption of a uniform reduction basis.

Government Relief Shipments Total 40,824 Carloads

Shipments of 40,824 carloads of foodstuffs, grains, blankets and coal for the needy unemployed were made by the Federal Surplus Relief Corporation from November, 1933, to March 15, 1934, inclusive, according to a statement issued by Harry L. Hopkins, president of the corporation and Federal Emergency Relief Administrator.

Pork shipments aggregated 105,082 tons; butter, 23,878 tons; lard, 5,279 tons; flour, 44,685 tons; dried apples, 442 tons; beans, 2,500 tons; canned beef, 9,027 tons; cereal foods, 6,564 tons; and cheese, 1,801 tons. Other items included 525,696 bags of oranges, totaling 592 carloads; 226,100 gal. of syrup, amounting to 62 carloads; 1,100,595 tons of coal, aggregating 22,012 carloads; 9,620,923 bushels of feed grains; and 1,032,304 blankets, amounting to 287 carloads.

New Haven Orders 50 Streamlined Passenger Coaches

Fifty passenger coaches embodying streamlining and other unusual features of design have been ordered by the New York, New Haven & Hartford from the Pullman-Bradley Car Corporation. The weight of the new coaches will be 100,000 lb. each, as compared with 135,000 lb. for present designs. In order to reduce wind resistance by deflecting air currents, an approach to a tubular cross-section has been adopted, and the overall height has been reduced 12 in. without the sacrifice of inside headroom. The cars are all air-conditioned, with the interiors planned to give the maximum in passenger comfort. The seats, which are planned on automotive lines, are provided with an ingenious pivot arrangement. It is anticipated that the streamlining of the cars, together with the reduction in weight, will be reflected in reduced fuel consumption.

Inventory of Railroads Lowest Since 1915

Inventories of unused materials on the Class I railroads of the United States on January 1, 1934, amounted to $295,000,000, the lowest total reported for any year since 1915, when the gross inventory was $248,888,000, according to the records of 128 railroads comprising 99.5 per cent of the total mileage operated by the Class I roads. The inventory on January 1 was approximately $26,598,000, or 8.5 per cent, less than the corresponding figure for 1932. Based on subdivisions reported by 81 companies operating 200,041 miles of lines, approximately $34,000,000, or 11.75 per cent, of the total inventory on January 1 consisted of new and second-hand rails, $51,500,000, or 17.5 per cent, consisted of crossties; $18,160,000, or 6.15 per cent, was fuel; $10,850,000, or 3.5 per cent, was unsold scrap iron, and $180,500,000, or 61.1 per cent, was miscellaneous materials.

Complete Burlington Streamlined High-Speed Train

The self-propelled, three-car, articulated, high-speed train of light-weight stainless steel which the Chicago, Burlington & Quincy ordered from the Edward G. Budd Manufacturing Company, Philadelphia, Pa., has been completed and was turned over to the railroad on April 18 in an elaborate ceremony at Philadelphia, which was marked by a broad-cast over the NBC system and the presence of many prominent railroad executives and industrialists. Following the ceremonies, during which the train was christened the "Zephyr," it commenced an extensive tour of the country, following the completion of which,

TRACK BOLT TENSION CONTROL IS NECESSARY

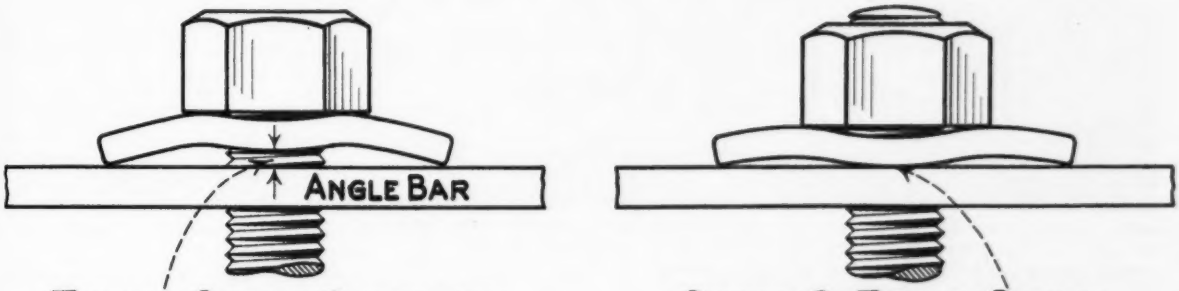
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The Bolt Tension Control of Verona Triflex Spring is such that all bolts in the joint will be of uniform tightness and yet prevent frozen joints

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"SINCE 1873"

early in July, the train will be placed on exhibition at A Century of Progress Exposition in Chicago. Eventually the train will be placed in service between Kansas City, Mo., Omaha, Neb., and Lincoln.

The train is driven by a Winton 600-hp. Diesel-electric power plant and is designed for speeds of approximately 110 miles per hour. In the design of the train, extensive wind-tunnel tests were conducted to develop the shape that would give the lowest air resistance, while two architectural firms collaborated in working out the arrangement, ornamentation and decoration of the passenger accommodations. The train consists of three car bodies carried on four trucks. It is 196 ft. long and weighs 195,000 lb. There is space for 72 passengers and 50,000 lb. of baggage and express, in addition to a 30-ft. mail compartment, a 16-ft. smoking compartment with seats for 20 persons, a solarium-lounge with chairs for 12 and a buffet-grill.

Safety Section Sets New Safety Goal for Railroads

A new safety goal for the railways, calling for a reduction of at least five per cent per year in injuries to employees on duty during the next six years, has been adopted by the Safety Section, American Railway Association. In working toward the new goal the Safety Section desires that each railroad formulate plans that may be appropriate to its own properties and work against its own previous records.

In 1924 the Safety Section set up a goal calling for a reduction of at least 35 per cent in all accidents to railway employees within a period of seven years. During this period a reduction of 70 per cent was actually accomplished. At the end of the seven-year period, or in 1931, a new goal was adopted which called for a reduction of at least 33 per cent in employee injuries by the end of 1933. While this goal was not fully attained, a reduction of 26 per cent was accomplished, and in 1933 the railroads made the best employee safety record in history.

Pennsylvania Encouraged by Storedoor Service Results

The Pennsylvania is satisfied that the principle of storedoor collections and delivery of l. c. l. freight is sound and will ultimately be extended and adopted throughout the United States, said Walter S. Franklin, vice-president in charge of traffic of the Pennsylvania in an address at New York on April 21. The l. c. l. storedoor service which the Pennsylvania established on December 1, 1933, Mr. Franklin revealed, "is currently bringing in gross revenues which are more than double the drayage costs, after deducting the plus charges." The Pennsylvania is, therefore, "satisfied that the experiment is now on a paying basis." While refusing to predict developments in connection with proposals for collection and delivery of carload freight, Mr. Franklin pointed out that a large proportion of such freight now actually does receive storedoor service on private sidings. He estimated that 80 per cent of the Pennsylvania's carload freight is so handled.

Association News

Metropolitan Track Supervisors' Club

The most recent meeting of the club was held at Keen's Chop House, New York, on April 26, when I. H. Schram, engineer maintenance of way, Eastern district of the Erie, discussed the subject of ties, from their purchase to their installation in the track.

The Bridge and Building Association

The executive committee has filled the vacancy resulting from the death of First Vice-President A. I. Gauthier by moving up H. I. Benjamin, assistant engineer, S. P., San Francisco, Cal., to first vice-president; T. H. Strate, division engineer, C. M. St. P. & P., Chicago, to second vice-president, and E. C. Neville, bridge and building master, C. N. R., Toronto, Ont., to third vice-president. A. B. Scowden, general bridge inspector, B. & O., Cincinnati, Ohio, has been appointed fourth vice-president to fill the vacancy thus created. C. M. Burpee, research engineer, D. & H., Albany, N. Y., has been appointed director to fill the unexpired term of Mr. Scowden.

Maintenance of Way Club of Chicago

Seventy members and guests attended the fourteenth annual meeting at the Auditorium Hotel on April 18, when J. B. Mabile, general maintenance inspector, Chicago, Rock Island & Pacific, gave an extended talk on the experiences and practices of his road in determining when ties required replacement. Mr. Mabile's remarks were illustrated by a moving picture film prepared by Fairbanks, Morse & Co.

The following officers were elected for the coming year: President, F. N. Hoyt, superintendent of track, Chicago Rapid Transit; first vice-president, V. R. Walling, principle assistant engineer, Chicago & Western Indiana; second vice-president, E. J. Brown, roadmaster, Chicago, Burlington & Quincy; and secretary-treasurer, W. S. Lacher, managing editor, *Railway Engineering & Maintenance* (re-elected).

American Railway Engineering Association

As a result of the decision to rebuild and enlarge the transverse-fissure detector car, owned by the American Railway Association and operated through its engineering section, (the A. R. E. A.) work on which is now in progress, authority has been granted for the purchase of a tow-car which will be employed in propelling the detector car. Heretofore, the A. R. A. detector car has been towed by equipment furnished by the railways over whose lines it was being operated.

The board of direction and four of the standing committees of the association have scheduled meetings for the month of May. The board of direction and the committee on standardization will meet in Montreal; the former on May 22 and the latter on May 21. Three other committees will meet in Chicago, namely, the Committee on Maintenance of Way Work Equipment, on May 1; the Committee on Waterways and Harbors on May 8, and the Committee on Iron and Steel Structures on May 10 and 11.

The Railway Tie Association

The Railway Tie Association will hold its annual convention at Cleveland, Ohio, on May 16-17. The meeting will open at 9 o'clock on Wednesday morning with the reports of officers and addresses by several railway and railway tie men on problems of special interest to the members of the association at this time. The session on Wednesday afternoon will be devoted to the consideration of the code for tie production which has recently been signed, and to the discussion of problems arising out of its application. The session on Thursday morning will be devoted primarily to the business of the organization, including reports on conditions in the various tie producing areas and the consideration of revisions in the constitution of the association to enable it more effectively to meet the conditions imposed by the code.

Employees Tax Leagues Meet

The annual meeting of representatives of various state associations of railway employees and other citizens which are fostering equalization of competitive conditions as between the railroads and other forms of transportation was held in Washington, D. C., on April 23-25, with an attendance of 75, representing 27 state associations, under the auspices of the National Advisory Council of the Railroad Employees and Taxpayers Associations. Reports of legislative and law enforcement conditions as regards motor transportation in the various states were reviewed and Jerome Fanciulli of the National Highway Freight Association addressed the group on behalf of Federal regulation of interstate commercial motor transport.

Railway Wage Reduction to Be Restored

The hourly wages of organized railway labor will be restored to the 1929 level by gradual periodic increases that will wipe out by April 1, 1935, the 10 per cent reduction that was made more than a year ago, according to an agreement reached on April 25 between representatives of the railroad management and the Railway Labor Executives Association. The agreement provides for restoration of one-quarter of the reduction on July 1, 1934, one-half on January 1, 1935, and the remaining quarter on April 1, 1935. With respect to employees in the lower paid brackets the agreement is not to be considered as preventing discussion and adjustment between individual carriers and labor organizations with respect to spreading employment.

The GUARD RAIL for main line service today



THE Bethlehem Hook Flange Guard Rail is made of *rolled* steel. It combines great strength with resilience.

At high speeds, when the back of a wheel flange comes in contact with the flare of this guard rail, it "gives" slightly, being resilient. It cushions the impact, straightens the truck without great shock and thereby guides the opposite wheels past the frog point without damaging blows. It's safe. Because of its rolled-steel construction it readily absorbs shocks that would otherwise cause severe strains, perhaps even cracks.

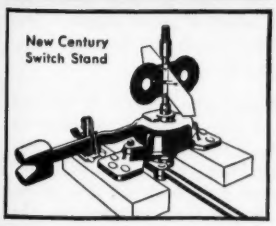
It may be going too far to say that the Bethlehem Hook Flange Guard Rail is unbreakable. Perhaps it *can* be broken, and maybe some day one will break. But this we do know: That of the many thousands of these guard rails in heavy, main-line service, some of them for a dozen years or longer, we've never heard of one that has broken. Not one!

Modern, high-speed, main-line service calls emphatically for the Bethlehem Hook Flange Guard Rail.

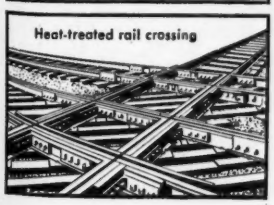
This guard rail is one member of a large group of track specialties manufactured by Bethlehem Steel Company. The complete line of Bethlehem Track Equipment answers completely and satisfactorily every modern railway requirement. Each item represents years of experience; each is a leader in its field.

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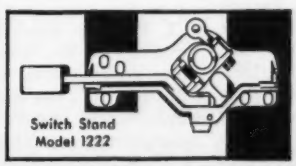
OTHER BETHLEHEM TRACK EQUIPMENT













BETHLEHEM *Track Equipment*

Personal Mention

Engineering

I. H. Schram, engineer maintenance of way of the Eastern district of the Erie, has had his headquarters moved from Jersey City, N. J., to 50 Church street, New York City.

C. J. Geyer, assistant to the vice-president in charge of operation of the Chesapeake & Ohio, has been appointed engineer maintenance of way, with headquarters as before at Richmond, Va., succeeding **James E. King,** whose death is noted elsewhere in these columns.

J. H. Kelly, division engineer of the River division of the New York Central, with headquarters at Weehawken, N. J., has been transferred to the Eastern division, with headquarters at New York, succeeding **F. S. Hunt,** whose retirement on pension was noted in the April issue. Mr. Kelly is succeeded at Weehawken by **J. N. Grim,** general supervisor of bridges and buildings at New York, and formerly division engineer of the Adirondack and Ottawa division, with headquarters at Utica, N. Y.

Track

M. B. McAdams, a track inspector on the Chicago, Rock Island & Pacific and formerly a roadmaster on this road, has been appointed acting roadmaster with headquarters at Eldorado, Ark., to replace **D. B. Griffin,** who is on a leave of absence because of ill health.

L. D. Beatty, assistant roadmaster on the Southern, with headquarters at Louisville, Ky., has been promoted to roadmaster at the same point, succeeding **C. J. Murphy,** deceased. The position of assistant roadmaster at Louisville has been abolished.

A. H. Whisler, track supervisor on the Pennsylvania at Milton, Pa., has been assigned to the office of the chief engineer maintenance of way at Philadelphia, Pa. **L. A. Evans,** assistant supervisor on the Philadelphia Terminal division, has been appointed acting supervisor at Milton to relieve Mr. Whisler.

C. R. Strattman, an instrumentman on the Michigan Central, has been promoted to roadmaster of the Air Line and Kalamazoo branches, with headquarters at Jackson, Mich., succeeding **Patrick Doherty,** whose death is noted elsewhere in these columns under Obituary. Mr. Strattman was born on November 9, 1887, at Waldheim, La., and was educated in civil engineering at the State University of Louisiana. He first entered railway service in 1904 as a laborer on bridge construction on the New Orleans Great Northern. During school vacations he served with the same railroad and in 1909 he entered the service of the Michigan Central as a rodman on construction, later serving as an instrumentman. In 1911 Mr. Strattman went with the Canadian Pacific and served in various capacities in the engineering departments of this company and the Canadian Northern (Now the Canadian National) until 1915 when he entered the service of a lumber company in Louisiana. During the following three years he completed his course at the University and served in the meantime as an instrumentman on oil refinery construction and as assistant city engineer of Baton Rouge, La. After serving for a time with an oil company and then with the American Bridge Company, Mr. Strattman returned to the Michigan Central in 1920 as an instrumentman, soon being promoted to assistant engineer. He served in the latter position and as an instrumentman until his recent promotion to roadmaster.

D. E. Smucker, assistant supervisor on the Philadelphia Terminal division of the Pennsylvania, has been promoted to supervisor on the Delaware division, with headquarters at Clayton, Del. **L. E. Gingerich,** supervisor on the Baltimore division, has been assigned to special work on the Maryland division.

Richard W. Torbert, assistant supervisor on the Reading, with headquarters at Pottsville, Pa., has been promoted to track supervisor, with headquarters at Philadelphia, Pa., to succeed **Raymond Westcott,** who has been transferred to Tamaqua, Pa. Mr. Westcott will succeed **W. S. Sloatman** who has been transferred to Pottstown, Pa., where he replaces **P. R. Bickford,** whose death was noted in the April issue. **Harry F. Bressler** has been appointed assistant supervisor at Tamaqua, to succeed **John W. DeMoyer, Jr.,** who has been transferred to Pottsville to succeed Mr. Torbert.

K. A. Werden, whose promotion to supervisor of track on the Pennsylvania, with headquarters at Oil City, Pa., was noted in the March issue, was born on October 22, 1905, at Wauconda, Ill., and was educated in the Wauconda Township high school and at the University of Illinois. He entered railway service with the Pennsylvania as assistant on the engineer corps on June 21, 1926, and on July 22, 1929, he was promoted to assistant supervisor of track, with headquarters at York, Pa. In September of that year he was transferred to West Philadelphia, Pa., and on January 5, 1931, he was again transferred to Huntingdon, Pa., where he was located at the time of his recent promotion.

Bridge and Building

T. P. Soule, supervisor of bridges and buildings on the Mohawk division of the New York Central, with headquarters at Albany, N. Y., has been appointed general supervisor of bridges and buildings, with headquarters at New York, succeeding **J. N. Grim,** whose promotion to division engineer is noted elsewhere in these columns. Mr. Soule is succeeded as supervisor of bridges and buildings by **E. E. Tanner,** formerly assistant supervisor of bridges and buildings on the Buffalo division, with headquarters at Rochester, N. Y., and Mr. Tanner's position as assistant supervisor has been taken by **William Cavanaugh,** assistant supervisor of bridges and buildings on the Syracuse division, at Rochester. **T. B. Coolidge** has been appointed assistant supervisor of bridges and buildings on the Syracuse division, with headquarters at Syracuse, N. Y.

Mr. Soule, who was born on December 14, 1876, at Orwell, N. Y., entered railway service on May 1, 1904, as a carpenter on the Rome, Watertown and Ogdensburg division of the New York Central, which was later divided into the St. Lawrence and Ontario divisions. On May 1, 1907, he was promoted to carpenter foreman on the R. W. & O. division, and later was made pile driver foreman on the St. Lawrence division. On February 1, 1919, he was promoted to assistant supervisor of bridges and buildings on the St. Lawrence division, with headquarters at Watertown, N. Y., and on October 1, 1922, he was promoted to main line assistant supervisor of bridges and buildings on the Syracuse division, with headquarters at Syracuse, N. Y. On December 1, 1926, Mr. Soule was further promoted to supervisor of bridges and buildings and supervisor of signals on the Adirondack & Ottawa division, with headquarters at Malone, N. Y., and on October 1, 1929, he was advanced to supervisor of bridges and buildings on the Mohawk division, with headquarters at Albany, N. Y., the position he was holding at the time of his recent promotion to general supervisor of bridges and buildings.

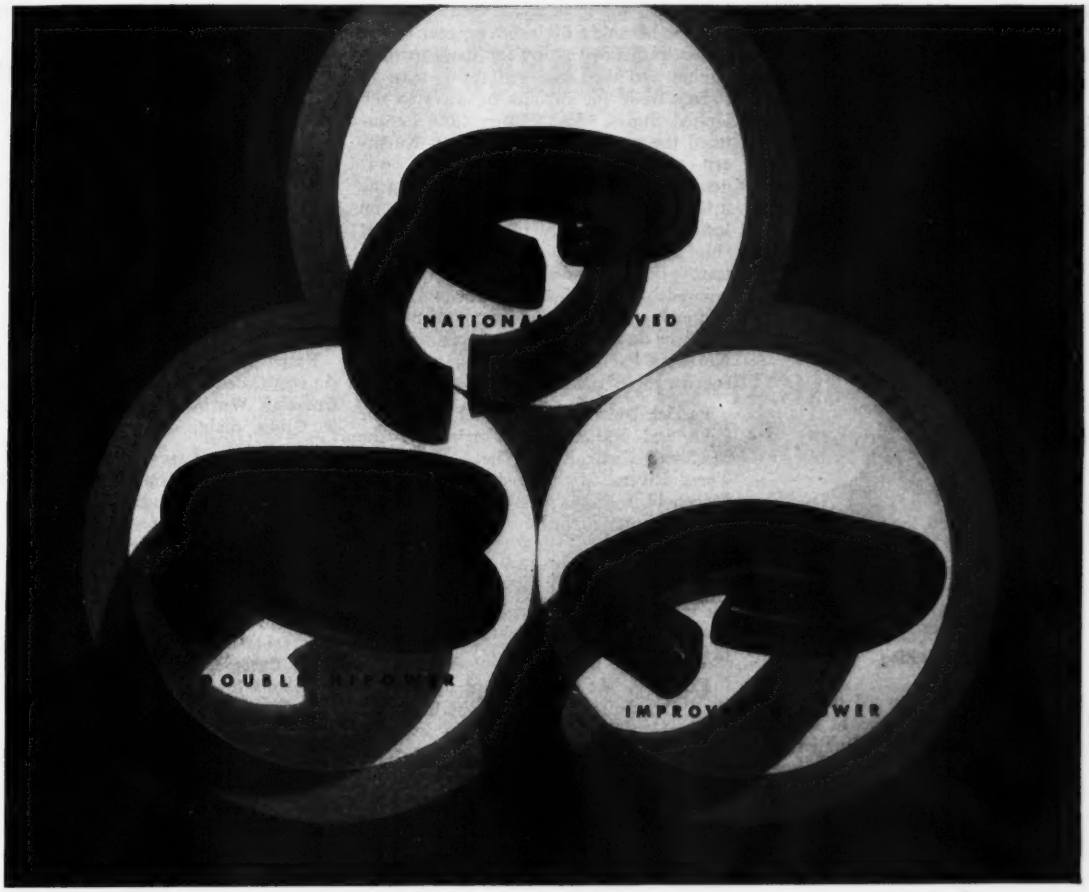
Obituary

R. T. Gollehon, who retired in 1923 as roadmaster of the Arkansas-Louisiana division of the Chicago, Rock Island & Pacific, died at Ruston, La., on March 15.

A. O. Wilson, division engineer on the Seaboard Air Line, with headquarters at Savannah, Ga., died at that point on April 17, following a short illness. Mr. Wilson had been with the Seaboard Air Line for 27 years.

Silas B. Peter, who retired in 1927 as roadmaster of the Northern division of the St. Louis-San Francisco, died at his home at Pittsburg, Kan., on February 24. Mr. Peter was born on December 26, 1860, at Rego, Ind., and entered the service of the Frisco as a track foreman at Belton, Mo. Subsequently he was promoted to roadmaster and served in this capacity at various points in Kansas until his retirement.

James E. King, engineer maintenance of way of the Chesapeake & Ohio, with headquarters at Richmond, Va., died suddenly of a heart attack at his home in that city on March 29. Mr. King was born at Hurricane, W. Va., on March 1, 1884. He was educated in the public schools of Barboursville, W. Va., and at Morris-Harvey College, entering the service of the C. & O. in September, 1900, as a carpenter at Huntington, W. Va. In March, 1906, he was appointed carpenter



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foreman at the same point and two years later he was made a rodman. Mr. King became an assistant engineer at Huntington in June, 1909, and in the following year he was appointed assistant engineer maintenance of way at that point. In June, 1914, he was further advanced to supervisor of bridges and buildings on the Big Sandy division, and in August, 1916, he was transferred to the Hunting-



James E. King

ton division where he served until July, 1918, when he was promoted to division engineer of the Hinton division. In July, 1925, Mr. King became general supervisor of bridges and buildings for the system, with headquarters at Richmond, Va., serving in that position until April, 1929, when he was promoted to assistant engineer maintenance of way of the system with the same headquarters. He was further advanced to engineer maintenance of way in June, 1929, and served in that position continuously until his death.

James B. McClain, assistant engineer of bridges of the Seaboard Air Line, with headquarters at Norfolk, Va., and formerly engineer of bridges of this company, died on April 19 at his home at Norfolk. Mr. McClain was born on June 24, 1877, at Washington, Pa., and entered railway service on July 1, 1906, as a masonry inspector on the Seaboard Air Line, serving continuously with this company until his death. In 1908 he was promoted to inspecting engineer and then to resident engineer three years later. In January, 1917, Mr. McClain was further advanced to assistant bridge engineer, being promoted to engineer of bridges in the following year. He held this position until 1931, when he was again appointed assistant engineer of bridges.

Samuel H. Sykes, who retired on December 31, 1922, as a district engineer on construction for the Canadian Northern Pacific (part of the Canadian National), died on March 16 at Vancouver, B. C. At the time of his retirement Mr. Sykes had been active in railway engineering work in Canada and the United States for 54 years. He was born on March 2, 1848, at Dublin, Ireland, and emigrated to Canada in 1868, where he became engaged on the location survey for the Whitby & Port Perry (now part of the C. N. R.). Later he was associated with the survey of a projected railroad in Ohio and a survey in Ontario for the Canada Southern. In 1883, he became a division engineer on location and construction for the Canadian Pacific and then engaged for a time in survey work for various railways in the United States. In October, 1898, he entered the service of the Canadian Northern (now part of the C. N. R.) as a resident engineer on construction, serving as a location engineer, division engineer on location and construction, and assistant chief engineer on location and construction. In November, 1917, he was appointed office engineer at Toronto, Ont., and in January, 1920, he was made district engineer on construction for the Canadian Northern Pacific. He retired from active service three years later.

Patrick Doherty, roadmaster of the Air Line and Kalamazoo branches of the Michigan Central, with headquarters at Three Rivers, Mich., died in that city on March 14, following a short illness. Mr. Doherty entered the service of the Michigan Central in May, 1888, as a track laborer, subsequently being advanced to track foreman and then to yard foreman. He was promoted to roadmaster at Three Rivers in 1920, holding this position until his death.

Frank P. Moffat, assistant director of the Bureau of Economics of the Canadian National, who for many years was engaged in engineering work with various railways throughout Canada, died at Montreal, Que., on March 19, following a lingering illness. Mr. Moffat was born at Pembroke, Ont., 51 years ago and was educated at the Royal Military College, Kingston, Ont. He entered railway service as assistant engineer on the Canadian Northern (now part of the Canadian National), subsequently serving as a leveler and transitman on the Grand Trunk Pacific (now also part of the C. N. R.) and as a transitman and resident engineer, successively, on the construction of the National Transcontinental (now also part of the C. N. R.). In 1910, Mr. Moffat became engaged on the construction of the Hudson Bay Railway, serving successively as engineer in charge, locating engineer, division engineer and resident engineer. In 1920 he entered government service as assistant office engineer in the Railways and Canals department at Ottawa, Ont., later being appointed assistant engineer. Mr. Moffat returned to the C. N. R. in 1923 as office engineer with the Bureau of Economics at Montreal, being advanced to assistant to the economist in 1929. In April, 1930, he was further promoted to assistant director of the Bureau of Economics, which position he was holding at the time of his death.

Transite Pressure Pipe.—The Johns-Manville Company, New York, has issued a 20-page well-illustrated brochure dealing comprehensively with its Transite pressure pipe, which is manufactured for a wide range of service in sizes from 3 in. to 36 in. in diameter and for carrying pressures from 43 to 217 lb. Among the features discussed in the brochure are the characteristics of the pipe; how it is made; types of joints used; methods of installation; advantages; specifications; and classes, sizes and weights.

Supply Trade News

General

The Gate City Iron Works, Omaha, Neb., has been appointed a distributor for Toncan copper molybdenum iron, which is manufactured by the **Republic Steel Corporation,** Youngstown, Ohio.

Personal

Ralph A. Brown has been appointed superintendent of the **Morden Frog & Crossing Works,** Chicago, to succeed **B. T. Gibbs,** resigned.

J. Clay Lee, assistant manager of the railway sales division of the **Standard Oil Company of Indiana,** has been appointed manager of the division, with headquarters at Chicago.

George J. Slibeck, formerly engineer of railroad sales of the Pettibone-Mulliken Company, Chicago, and more recently a representative of the **Morrison Metalweld Process, Inc.,** has returned to the **Pettibone-Mulliken Company,** as sales representative.

John B. Campbell, who has been appointed general manager of the **Pettibone-Mulliken Company,** Chicago, graduated from DePauw University in 1922 and in the same year entered the employ of Fairbanks, Morse & Co., Chicago. After hold-



John B. Campbell

ing positions in various departments, he was placed in charge of the production control division of the plant at Beloit, Wis., from which position he resigned in 1932. In the same year he was appointed special representative of the receiver of the Pettibone-Mulliken Company, which position he held until his recent promotion to general manager.

Welding of Genuine Wrought Iron.—The A. M. Byers Company, Pittsburgh, Pa., has issued an 8-page illustrated pamphlet, containing a discussion of the methods and procedure for welding wrought iron. A complete table of sizes of welding fittings that are available in wrought iron is also included.

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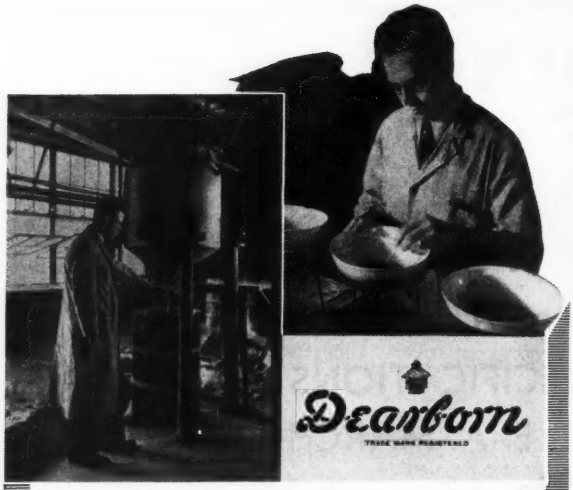
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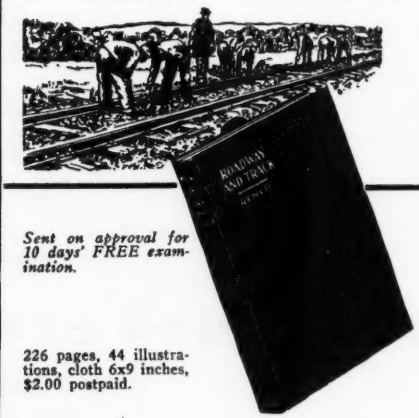
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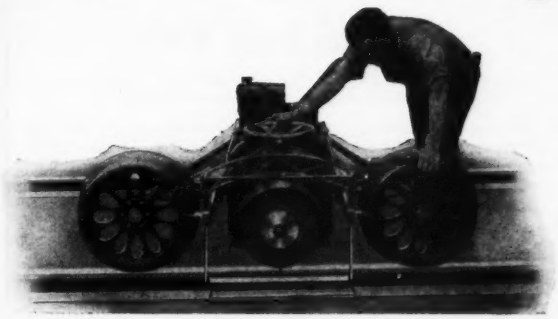
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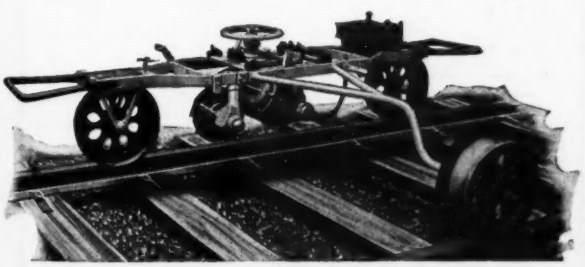
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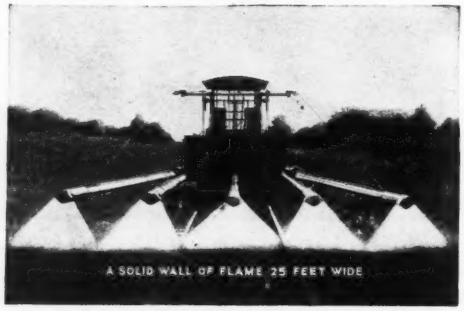


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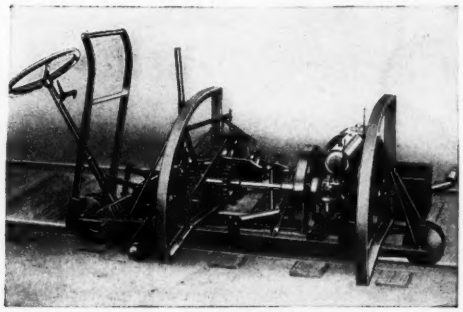


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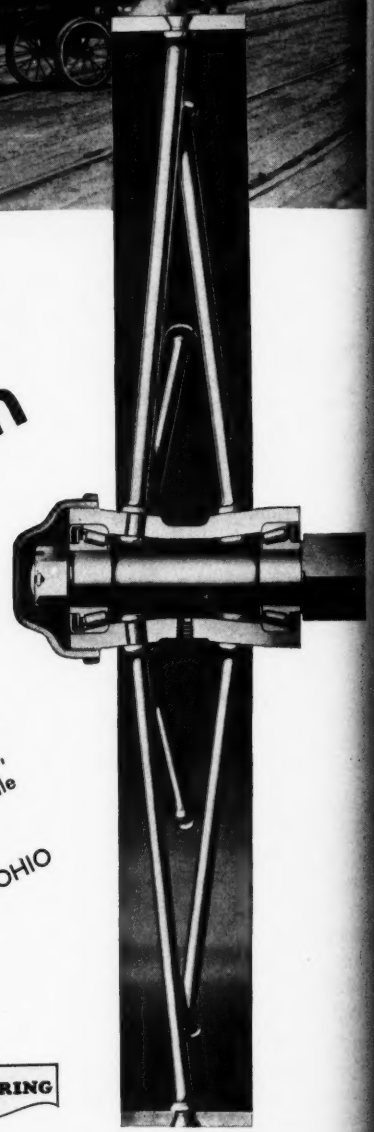
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